(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL

DECEMBER, 1905.

CONTENTS.

EAST MOLINE LOCOMOTIVE SHOPS.

ROCK ISLAND SYSTEM.

II.

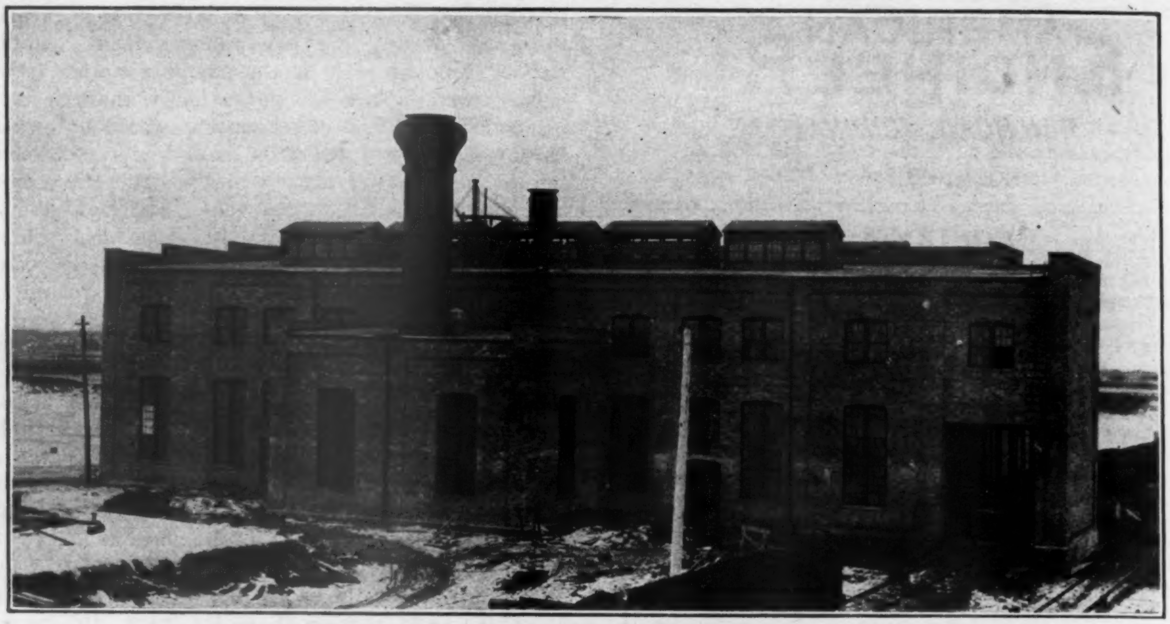
POWER HOUSE.

The power house is located centrally with regard to the locomotive and car departments, and is equipped to furnish power for both of them, although it will probably be some time before the car department is installed. Careful provision has been made to avoid the necessity of a shutdown, due to the failure of any of the machines or equipment. The building is large enough to accommodate a considerable increase of equipment and, if necessary, can be extended to the north. Due to the use of a conveyor for coal and ashes and to the Green chain grates, the boiler room presents a very clean and neat appearance. Mechanical draft is used in place of the usual high chimney, and the induced draft plant used in connection with an economizer is not only very efficient, but is less expensive than the ordinary arrangement where a high chimney is used. Although a low grade of Illinois coal is burned, the stokers and draft may be so nicely regulated that no smoke escapes from the chimney. As the exhaust steam is used for heating the shops, the engines are run non-condensing. Direct current at 230 volts is provided for the cranes, heating fans and constant speed machine tool motors. For the variable speed machine tool motors and the lighting, current at 230 volts and 115 volts is furnished by a three-wire system, the two voltages being obtained by a Bullock balancer set. As the pumping station is located almost two miles from the power house, the first cost of wire for transmitting the direct current would be excessive, and an inverted rotary converter and a static oil-cooled transformer in the power house transform the direct current into alternating current at 2,300 volts. The plant is to be commended for its completeness, its economical operation, the guards which are provided to prevent the necessity of a shutdown due to accidents, and the provision for future extensions.

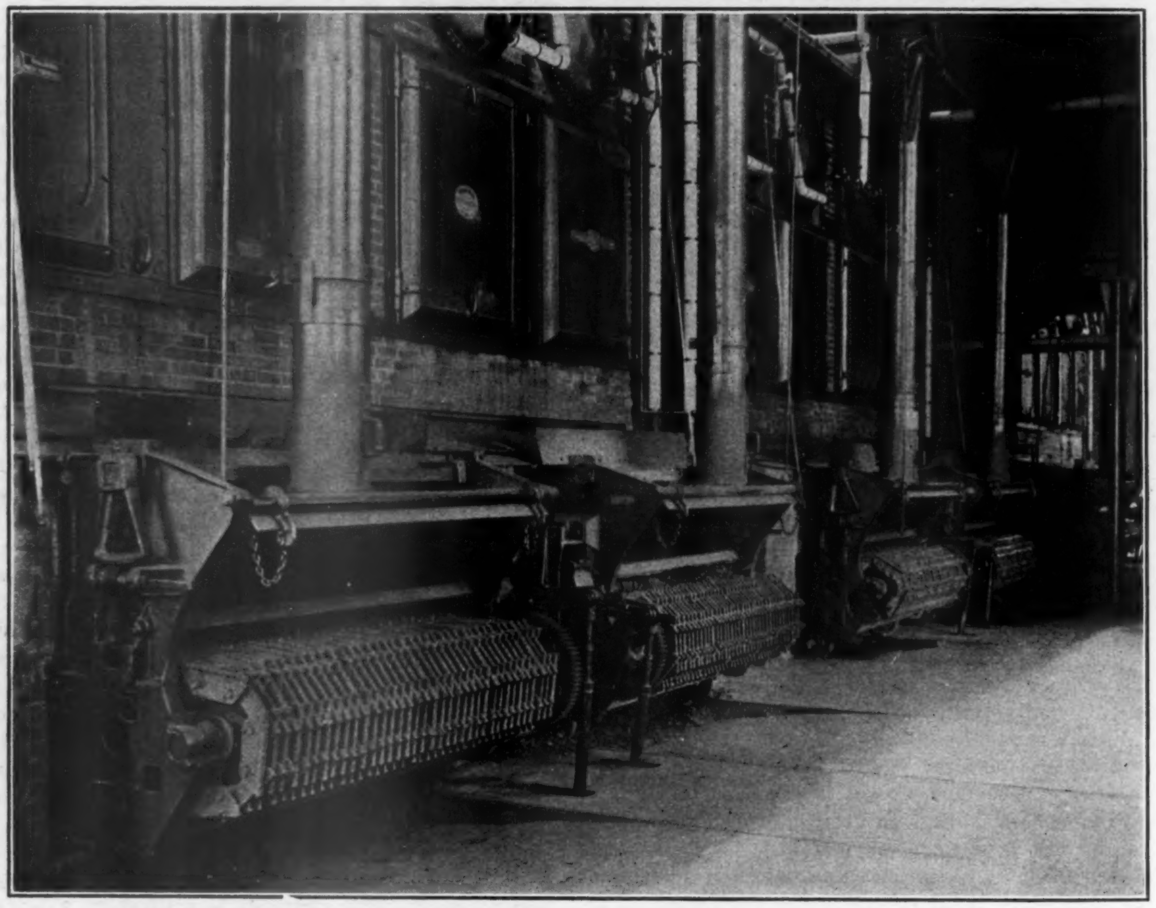
Building.—The power house has concrete foundations, brick walls and a gravel roof supported on steel trusses. The roof construction is the same as used on the other buildings, and is described on page 392. The basement is 9 ft. high, and in addition to the stairway leading to the engine room has an outside stairway of concrete. The main floor is of concrete supported by cast iron columns and steel beams. The power house lies about 60 ft. to the north and 95 ft. to the east of the store house. It is 154 ft. 2 ins. by 104 ft. 7 ins., and is divided longitudinally by a brick wall into a boiler room and an engine room, each 49 ft. 10 ins. wide. On the west is an addition 45 ft. by 27 ft. 6 ins., containing the induced draft apparatus, and on the south is an addition 18 ft. by 33 ft., through which the coal supply track runs; below this track is the coal hopper, and above is the ash hopper used in connection with the coal and ash conveyor. The height from the floor to the roof truss in the engine room is 30 ft. The engine room is equipped with a 10-ton overhead traveling crane which is operated by hand. The interior finish of the boiler room is a dark-red pressed brick. The engine room is finished in buff-colored pressed brick, with a wainscoting of white enamel tile 7 ft. high, with a baseboard and coping of dark green. The machinery is painted dark green, and the engine room thus presents a very neat and handsome appearance.

Boilers and Stokers.—Six 300-h.p. Babcock & Wilcox vertical header type boilers are set in three batteries of two each with their backs 10 ft. from the dividing wall. The furnaces are 8 ft. in height, measured from the floor line to the bottom of the header. This extra height is specially valuable in providing a large combustion chamber for highly volatile fuels. The boilers carry 150 lbs. of steam, and are equipped with Green chain grates. Two additional boilers are to be added, as indicated by the dotted lines in the drawing, and, if necessary, a boiler may be added at each end of the row. The piping is so arranged that these additions may be made without interruption to the service. The breeching is lined with firebrick, and is carried on columns along the dividing wall, leaving a pasageway underneath it, and sufficient room between it and the boilers for a man to work around or to enter the manholes in the back of the drums. The passageway to the engine room leads between the boilers at the center of the room. The Green chain grate stokers are driven by two 6-h.p. engines located in the basement.

Economizer.—Directly above the passageway to the engine room is the economizer chamber, which is supported on cast iron columns. This chamber is divided by a brick partition into two unequal flues, the larger of which contains a Green economizer. The other is used as a by-pass when the economizer is being cleaned or repaired. The economizer consists of 60 sections of 10 tubes, arranged in groups of 20 sections each, making a total of 600 tubes, with a heating surface of 7,200 sq. ft. The tubes are of cast iron, 9 ft. long, and are cleaned automatically with Green patent beveled scrapers. By means of dampers in the breeching at either side of the entrance to the economizer either battery of boilers may be cut off. Spouts with tight-fitting covers project downward from the economizer chamber, and bags are tied over them to collect the soot, which is swept down when the economizer tubes are cleaned, thus preventing the dirt from getting out into the room. The temperature of the feed water is about



POWER HOUSE, EAST MOLINE SHOPS, ROCK ISLAND SYSTEM.



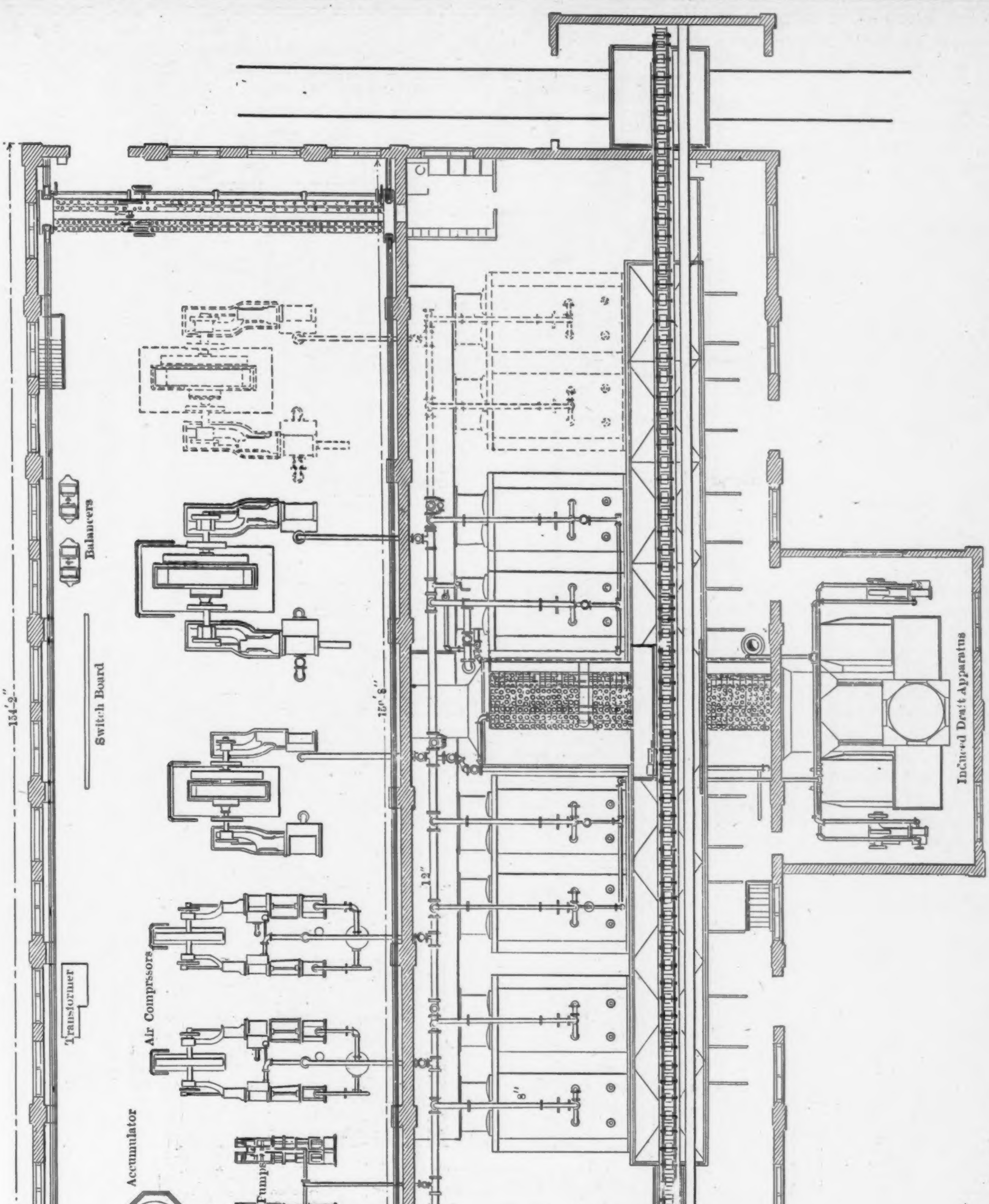
BOILER ROOM, SHOWING CHAIN GRATE STOKERS.

200 deg. as it enters the economizer and 275 deg. as it leaves.

Induced Draft Apparatus.—The induced draft apparatus consists of two exhaust fans, 12 ft. in diameter and 6 ft. wide, driven by 12 by 12-in. longitudinal single cylinder engines built by the Buffalo Forge Company. The speed of the engines is regulated by Foster regulating valves. Either of these fans is of sufficient capacity to handle all the gases from the complete boiler equipment, and dampers are provided to cut off whichever fan is not in use. The stack is of steel, 60 ft. high and 7 ft. 8 ins. inside diameter. The first cost of the steel stack, induced draft apparatus and economizer combined is just about the same as the first cost of a brick chimney for a plant of the same size, and the saving due to the use of the economizer is considerably larger than the cost of operating the induced draft apparatus, so that a net saving results from the use of this system.

Coal and Ash Conveyor.—The arrangement of the coal and ash conveying machinery is clearly shown in the longitudinal cross-sectional view through the boiler room. The coal is delivered directly from hopper cars to a hopper just above the steam-driven coal crusher, and after passing through the crusher is conveyed to overhead storage hoppers by a C. W. Hunt & Company conveyor, which has a capacity of 50 tons of coal per hour. Each boiler has a storage bin of 32 tons' capacity.

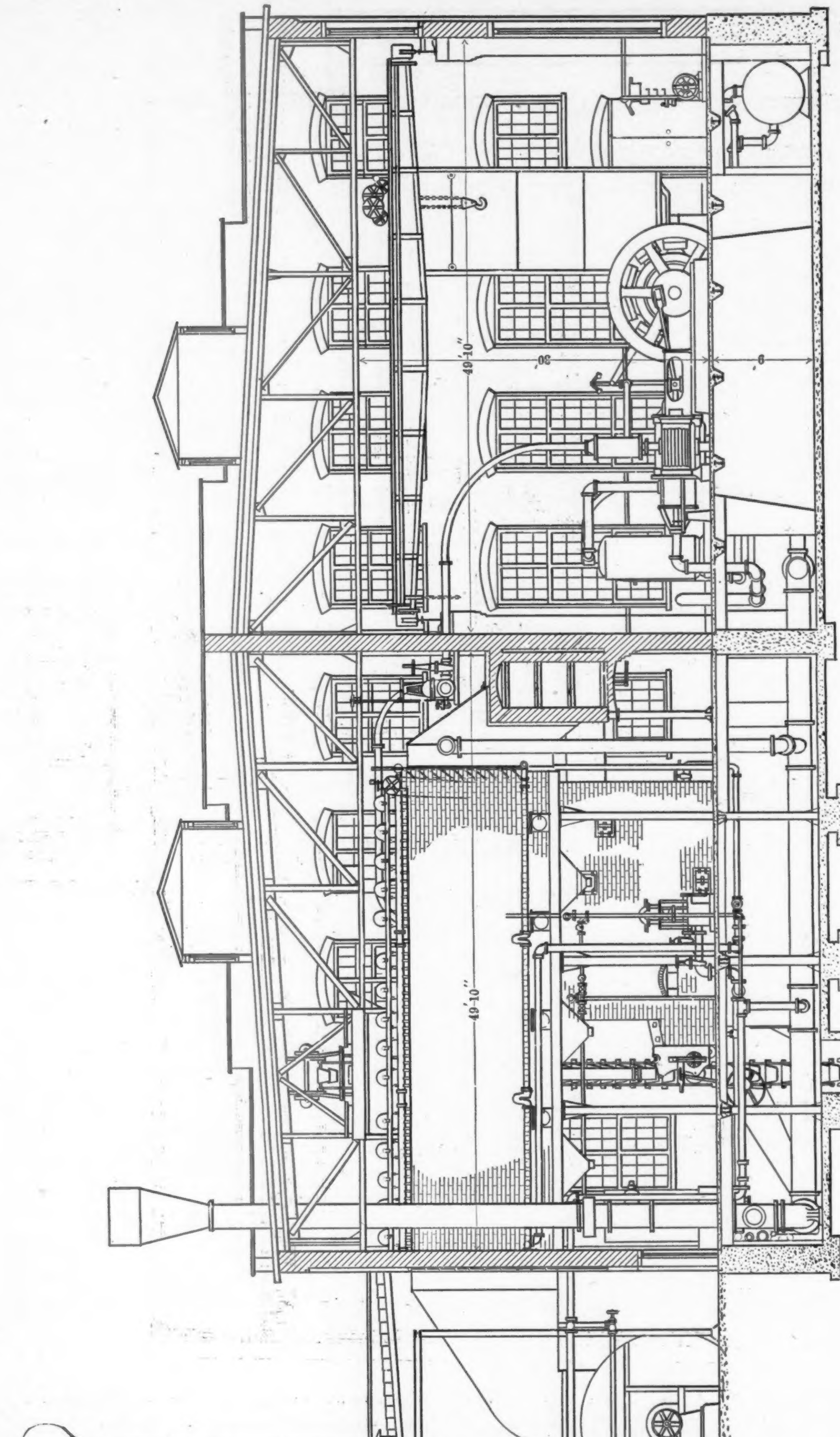
The conveyor also carries the ashes from the ash pits to a



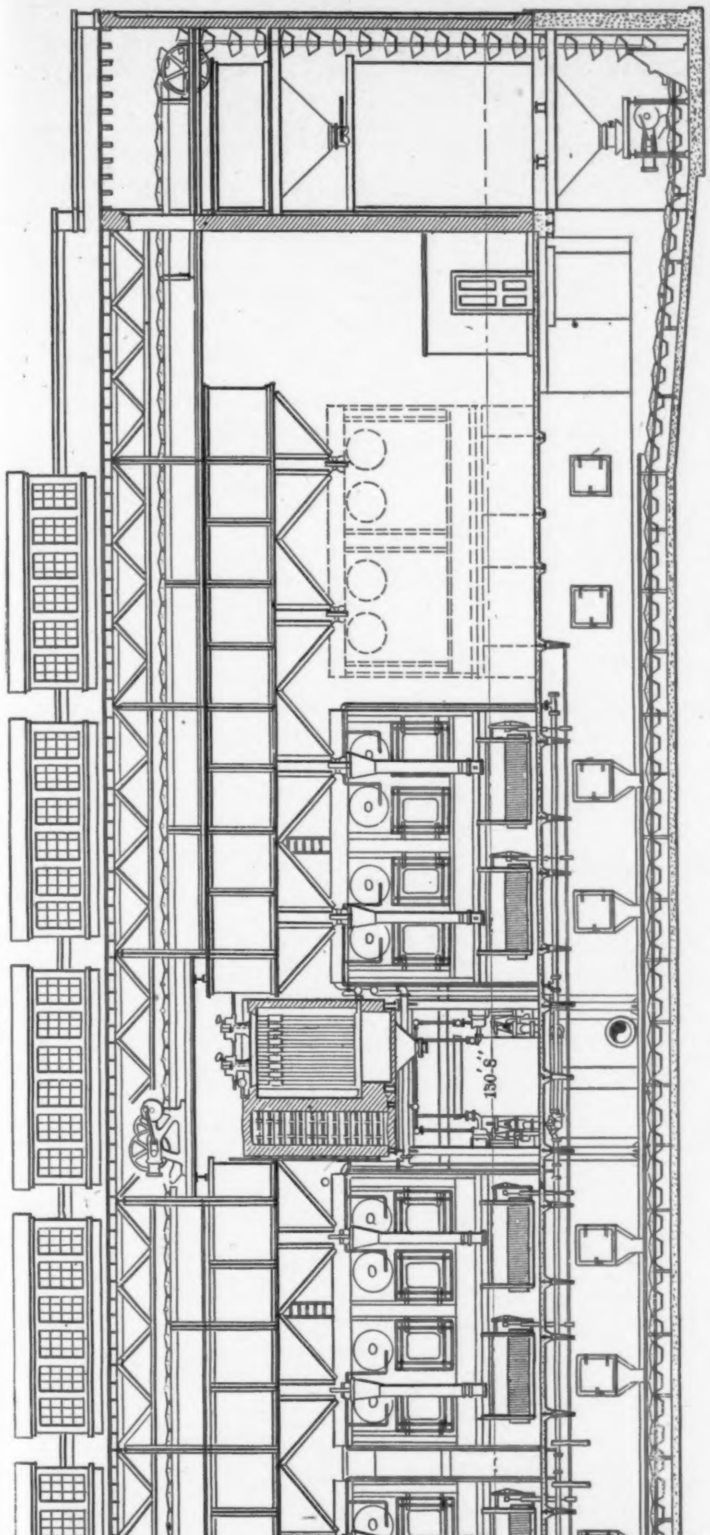
PLAN VIEW OF POWER HOUSE—EAST MOLINE SHOPS.

hopper located in the wing and over the coal hopper, so that the hopper car, when it has been emptied of its load of coal, may be filled with ashes. The engine which drives the conveyor is located above the economizer. Steam is used in preference to electricity as a motive power for the crusher and conveyor, as occasions may arise when it is desired to handle coal or ashes when the generators are not running and also because in case of stalling the motor would be liable to injury while the engine would simply slow down and stop.

Boiler Feed Pumps.—Two Worthington Admiralty boiler feed pumps, 10 and 7 by 10, are installed on either side of the passageway between the boilers. They are arranged to draw from the Webster vacuum heater tank, to which is supplied both fresh feed water and condensed water brought back from the heating system by two Marsh vacuum pumps 10 and 12 by 12. This heater also receives the water from the inter-coolers of the air compressors and from the water-cooled bearings of the induced draft fans. The feed pumps deliver water to the boiler feeding header through the economizer; a by-pass is provided, however, in case the economizer is out of service.



TRANSVERSE CROSS-SECTION THROUGH POWER HOUSE—EAST MOLINE SHOPS—ROCK ISLAND SYSTEM.



LONGITUDINAL CROSS-SECTION THROUGH BOILER ROOM—EAST MOLINE POWER HOUSE.

Piping.—The arrangement of the piping is clearly shown in the cross-sectional views of the power house. The steam pipes from each boiler are 8 ins. in diameter, and have a riser of about 10 ft. and a drop to the header. The header is 12 ins. in diameter, and is supported on a platform which extends along the partition wall on the boiler room side. The steam piping to the engine is 7 ins. in diameter, and has a long sweep of 8 ft. 6 ins. radius. A separator is located directly above the cylinders. The main exhaust pipe is 24 ins. in diameter, is laid along the basement floor, and has a branch to the feed water heater. All high-pressure piping is fitted with the Holly return loop system for handling the condensation.

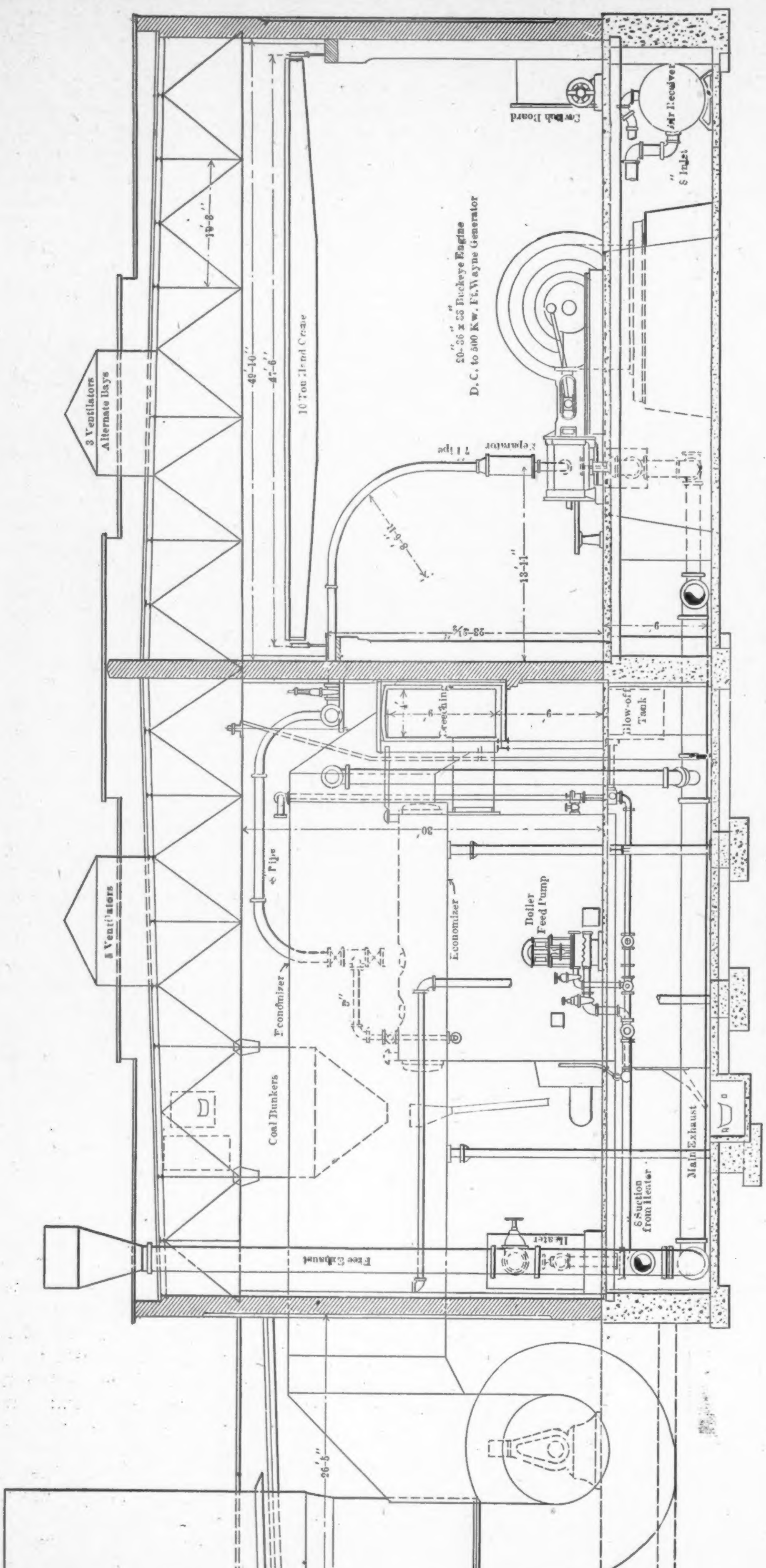
Engines.—The engines are direct connected to the generators, and are Buckeye heavy duty class B cross compounds, and are run non-condensing under 150 lbs. steam pressure. Space for an additional engine and generator is provided as shown by the dotted lines on the floor plan. The larger one is 20 and 36 by 33, and operates at 130 r.p.m. It is rated at 800 h.p., has a 2 per cent. speed regulation from no load to full load, and has a guaranteed steam consumption at economical range of 19 lbs. per horse power hour. The smaller engine is 15¼ and 26½ by 27, and operates at 150 r.p.m. The nominal rating is 400 h.p.; it has a 2 per cent. speed regulation from no load to full load, and a guaranteed steam consumption of 21 lbs. per horse power hour.

Oiling System.—The oiling system is of the J. H. Siegrist automatic type, and is operated by four small Worthington pumps. Two of these pumps supply a line of piping for cylinder lubrication under 165 lbs. pressure, and two supply another line of piping for engine oil under 40 lbs. pressure. In each case one of the pumps is a reserve unit. In case the pump furnishing the cylinder oil should get out of order and the pressure in the line be reduced, it would, of course, be noticed before any damage could be done. In the case of the engine oil, however, considerable damage might result before the stopping of the pump would be noticed, and therefore the gauge for this line of piping is so arranged that when the pressure falls to 10 lbs. an electric contact will be made and an electric alarm bell will ring.

Generators.—The generators were made at the Fort Wayne Electric Works under contract with the General Electric Company, and are of the M. P. L. type, direct current and direct connected. The larger one is a 10 pole, 500 k.w., 130 r.p.m., 250-volt machine, with a vertically split frame. The smaller one is a 10 pole, 250 k.w., 150 r.p.m., 250-volt machine. They are guaranteed to operate at the full rated load continuously with a rise in temperature above the surrounding air not exceeding 35 deg. C. on the armature and field coils and 40 deg. C. on the commutator. With the current increased 50 per cent. at the rated voltage, making a 50 per cent. overload, the generator will operate for two hours with an increase in temperature not exceeding 55 deg. C. in any part of the machine. They will carry a momentary overload of 100 per cent. without injury. Space is provided for an additional 500 k.w. unit.

Balancers.—Two Bullock balancers, one of them a reserve unit, and each of 25 k.w. capacity, furnish the two voltages for the three-wire system.

Air Compressors.—Two class "G. C." Ingersoll-Sargeant air compressors are provided. They are cross compound, steam-driven and non-condensing. The steam cylinders are 18 and 30 ins. in diameter, while the air cylinders are 16½ and 26¼ ins. in diameter, with a 24-in. stroke. The steam pressure is



TRANSVERSE CROSS-SECTION THROUGH POWER HOUSE—EAST MOLINE SHOPS.

150 lbs. and the air pressure 100 lbs. The normal speed of the machines is 90 r.p.m., at which they each have a free air capacity of 1,274 cu. ft. per minute. The intake pipe which delivers the cold air from the outside is 12 ins. in diameter. The compressors discharge into a main air receiver, 66 ins. by 16 ft., located in the basement, and from this receiver an 8-in. air main leads to the shops.

Pumps and Accumulator.—At the north end of the engine room are two compound Worthington duplex steam-driven pumps with 14 and 20-in. steam cylinders, 3½-in. plunger and 15-in. stroke, each having a capacity of 150 gals. of water per minute, delivered at a pressure of 1,500 lbs. per sq. in. The hydraulic accumulator is of the ordinary vertical plunger type, with a ram 12 ins. in diameter.

Pure water is obtained for the hydraulic system and for drinking purposes from a well just east of the power house. It is pumped by a triplex, double-acting Deane 10-h.p. electric pump, located in the basement, and having a capacity of 200 gals. per minute.

Water Supply and Fire Protection.—The water supply is obtained from the Mississippi River. The pumping station is located 9,600 ft. from the power house, 400 ft. from the river and 750 ft. from the end of the intake pipe. It is a neat building of dark-red brick, 20 by 40 ft., with a slate roof. It contains two Deming triplex pumps, each having a capacity of 750 gals. per minute. One of these, which is a reserve unit, is driven by a direct connected 60-h.p. Otto gasoline engine; the other one is driven by a 2,180-volt General Electric 50-h.p., 3-phase, 25-cycle induction motor. The alternating current is secured from an inverted 50-k.w. General Electric rotary converter, which is located at the power house, and delivers the alternating current at 25 cycles to a static oil-cooled transformer, which steps it up to 2,300 volts. The intake water main is 12 ins. in diameter, while the main to the plant is 10 ins. in diameter. The water is delivered to two tanks, each of 100,000 gals. capacity. One is a high-service tank, and is elevated 108 ft. and furnishes water for fire protection and for washing boilers. The low-service tank is elevated 20 ft., and furnishes sufficient pressure to distribute water over the plant. By means of valves, which may be operated from the power house, the low-service tank may be cut out and the high-pressure tank may be connected to the low-pressure mains, thus increasing the pres-

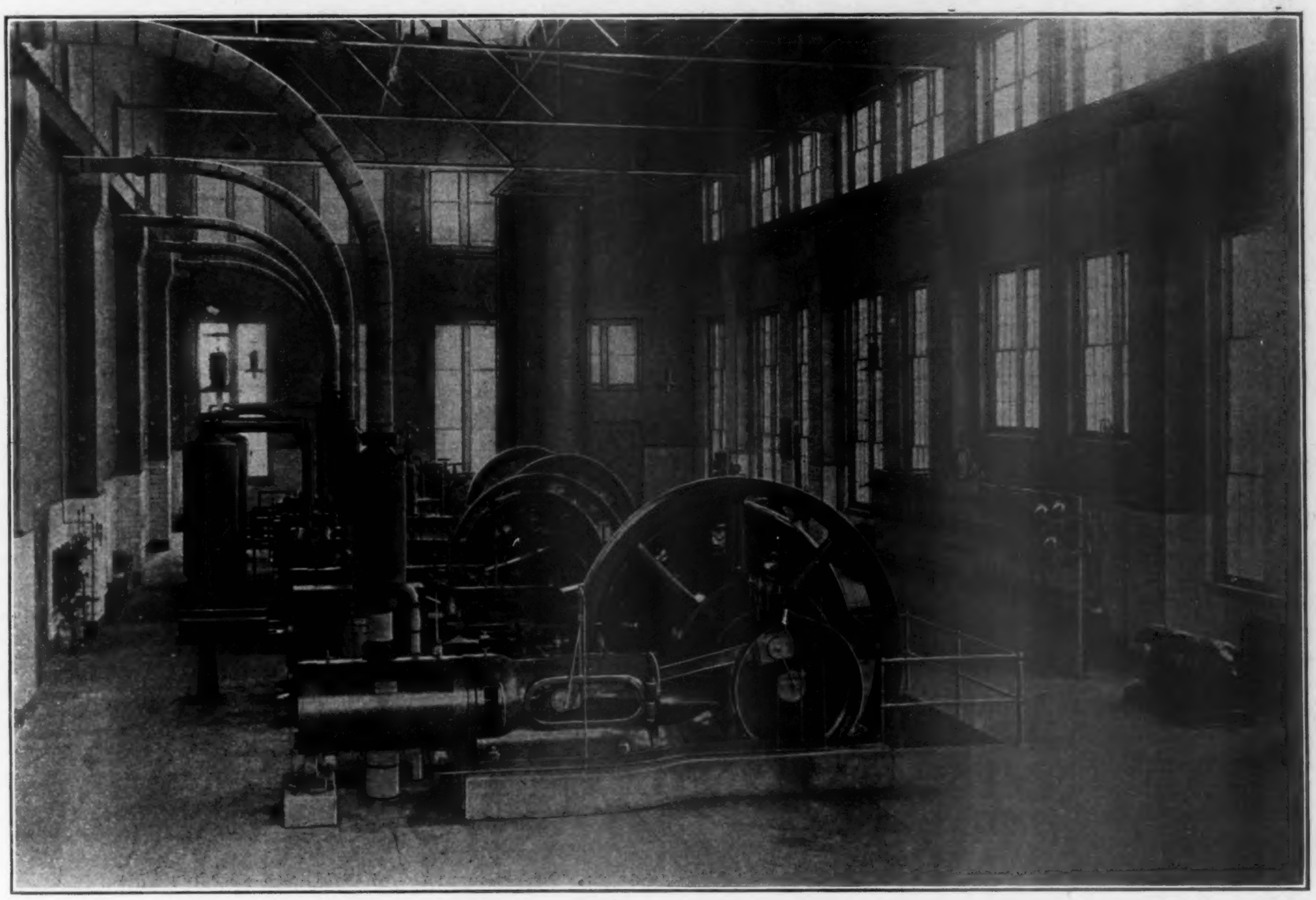
sure. The more important fire hydrants are on the high-pressure line, but a number of fire hydrants are on the low-pressure line, and in case of fire the low-pressure tank is cut out and the high-pressure tank is connected to the low-service line.

A Fairbank-Morse Underwriters' fire pump, capable of delivering 1,500 gals. per minute or 6⅛ in. streams at 100 lbs. pressure, is located in the southwest corner of the power house basement. Water is obtained direct from supply main from the pumping station with the low-service tank connected as a reservoir on the pump intake. The discharge is connected direct to a 12-in. service main. In addition to this the storehouse is provided with a sprinkler system, which, by an arrangement of check valves, is constantly under pressure from the high-service tank, and is automatically put on fire pressure when underwriters' pump is in operation. In case of fire it is necesary to operate but two valves to put the entire water system under fire pressure. Steam for operating the pump is taken from the south end of main steam header in boiler room, and delivered to pump through a 5-in. direct separator. The pump is controlled by a Fisher governor. The water works system was installed by the Otto Gas Engine Company, Chicago.

Hot Water.—Hot water at 210 deg. Fahr. is supplied from the Webster feed water heater to all the buildings. The outgoing lead is 2½-in. pipe, and from the end of each branch a ¾-in. pipe leads to a 1-in. main return pipe. The pressure is about 40 lbs. A circulation is maintained in the loops, thereby giving hot water at any point immediately upon opening the valve. This is done by a three-stage Lawrence centrifugal pump, located in the basement, and driven by a compound wound 10-h.p. General Electric motor, which operates continuously. The water pressure is determined by the quantity of the discharge, and to keep the pressure constant and thus keep the water circulating it is necessary to automatically regulate the speed of the pump. A solenoid governor varies the resistance in the shunt-field circuit of the motor, thereby maintaining better regulation than by the customary method of armature control. A variation of 10 per cent. in the speed of the pump will produce a variation of 3 to 1 in its output.

Heating System.—The exhaust steam is used for heating the buildings, the Webster vacuum return system being employed in connection with the Sturtevant system. This subject will be considered in detail in connection with the description of the equipment of the various buildings.

Switchboard.—The electrical load is divided into five classes of service supplied by eight feeders, as follows: cranes, 185 k.w.; heating fans, 245 k.w.; constant speed machine motors, 415 k.w.; variable speed machine motors, 175 k.w.; lighting (4 feeders), 189 k.w.; total, 1,209 k.w. Of these the first three are two-wire 230-volt lines, and the last two are three-wire 230-115-volt lines. The main switchboard has twelve panels, assigned as follows: 2, generators; 1, totalizing; 1, cranes and heating fans; 1, constant speed motors (to also carry wood-working machinery later); 2, balancer; 1, three-wire variable speed motors; 4, three-wire lighting. The load factors for maximum current demand on the various feeders were allowed as follows: Cranes, 800 amperes (arbitrarily determined); heating fans, 100 per cent., rated capacity; constant speed, 75 per cent. rated capacity; variable speed, 65 per cent., rated capacity; lighting, 100 per cent., rated capacity.

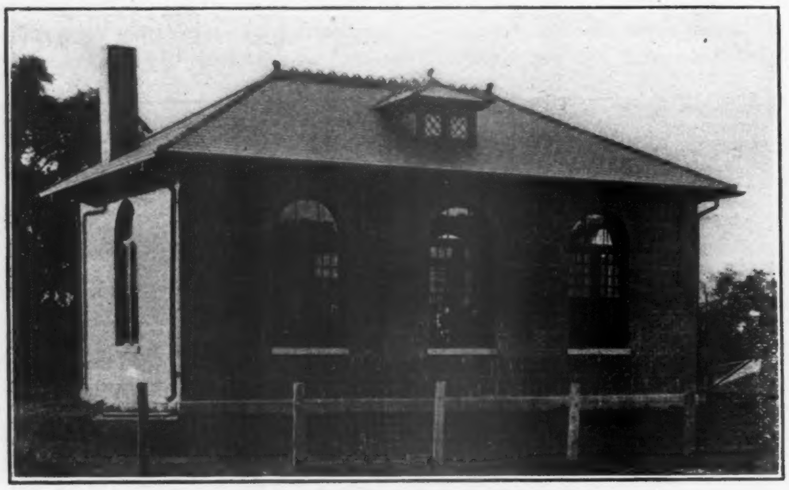


ENGINE ROOM—EAST MOLINE SHOPS' POWER PLANT.

The lighting and variable speed motors are on the three-wire system and feed from the same balancer. Considerable trouble has been experienced in keeping the feeders balanced so as to avoid a fluctuation in the lights caused by the starting and stopping of the motors. To overcome this, the neutral bar bus has been divided in two sections, one for lighting and the other for variable speed motors. A switch is provided on the rear of the switchboard, so that the two sections may be connected together as one. With this arrangement one balancer is used for the lighting, while the other takes care of the variable speed motors. Through the day, with a small

lighting load, this fluctuation is of little importance; the switch on rear of board is closed, and the lighting and motors supplied from the same balancer. In the evening, when the lighting load increases, both balancers are used, and the switch on the rear of the board is opened, so that the lighting and variable speed motors are then independent of each other. The result of this change is very noticeable in the life of lamps, besides a much improved lighting service.

Tunnels.—A tunnel which carries the electric wires and piping leads from the power house to the various buildings. It is 6 ft. 6 ins. high and 6 ft. wide at the power house and 5 and 4 ft. wide at other points, according to the demand for space. The tunnel is concrete, and the roof is 6 ins. thick, reinforced by expanded metal. At points where tracks in the yard cross the tunnel the roof is strengthened by old rails laid crosswise. At suitable intervals openings 2 ft. 8 ins. wide and 8 ft. long are located for the purpose of introducing lengths of pipe. These openings are covered by substantial grids. The aggregate length of the tunnel is 2,120 ft., and suitable provision is made for ventilation and drainage. The pipes are carried at one side and the electric wires at the other. At intervals of 6 ft. upright pieces of 6 by 4-in. oak are set into the concrete sides, and cast iron brackets, which carry cast iron chairs for the pipes, or glass insulators for the wires, are secured to them by lag screws.



PUMPING PLANT—EAST MOLINE SHOPS.

Lockers and toilet arrangements for the power house force are provided in one corner of the boiler room.

We are indebted for information and drawings to Mr. C. A. Seley, mechanical engineer, and Mr. C. H. Wilmerding, consulting engineer, of Chicago.

Locomotive Testing Plant.—A locomotive testing laboratory is to be built in Germany at the Grunewald Works, on similar lines to that at the St. Louis Exposition. It is to be in charge of the well-known locomotive designer, Professor Von Borries.

Electrification of the Duluth, Missabe & Northern Railway.—It is reported that as soon as possible this road will adopt electricity as a motive power. The plans will probably include the use of electrical apparatus for unloading the large steel ore cars at the docks.

Shop Telephone Systems.—One of the most valuable adjuncts to a well-organized shop is a telephone system for every foreman, and if it were possible to figure accurately the time so saved every railroad shop of medium or large size would be equipped with a telephone system. If the shop was quite small—handling only three or four engines—it might not be a good investment, but in any shop holding five or more engines it will give large returns.—*Mr. M. K. Barnum, before the Western Railway Club.*

STEEL CAR DEVELOPMENT.

Pennsylvania Railroad.

VIII.

(For previous Article See Page 358.)

FLAT AND GONDOLA CARS.

The class designated as Fm is a very strong flat car of 100,000 lbs. capacity, built of steel with a wooden floor, and having stake pockets. It is built for concentrated loads which in this series of cars provide for carrying two-thirds of the capacity of the car on a line across the floor or anywhere between the cross bearers. The Fm and Gr classes are both built for such loads, while the Gs classes, of which there are four, Gs, Gsa, Gsb, Gsc, are built for uniformly distributed loads.

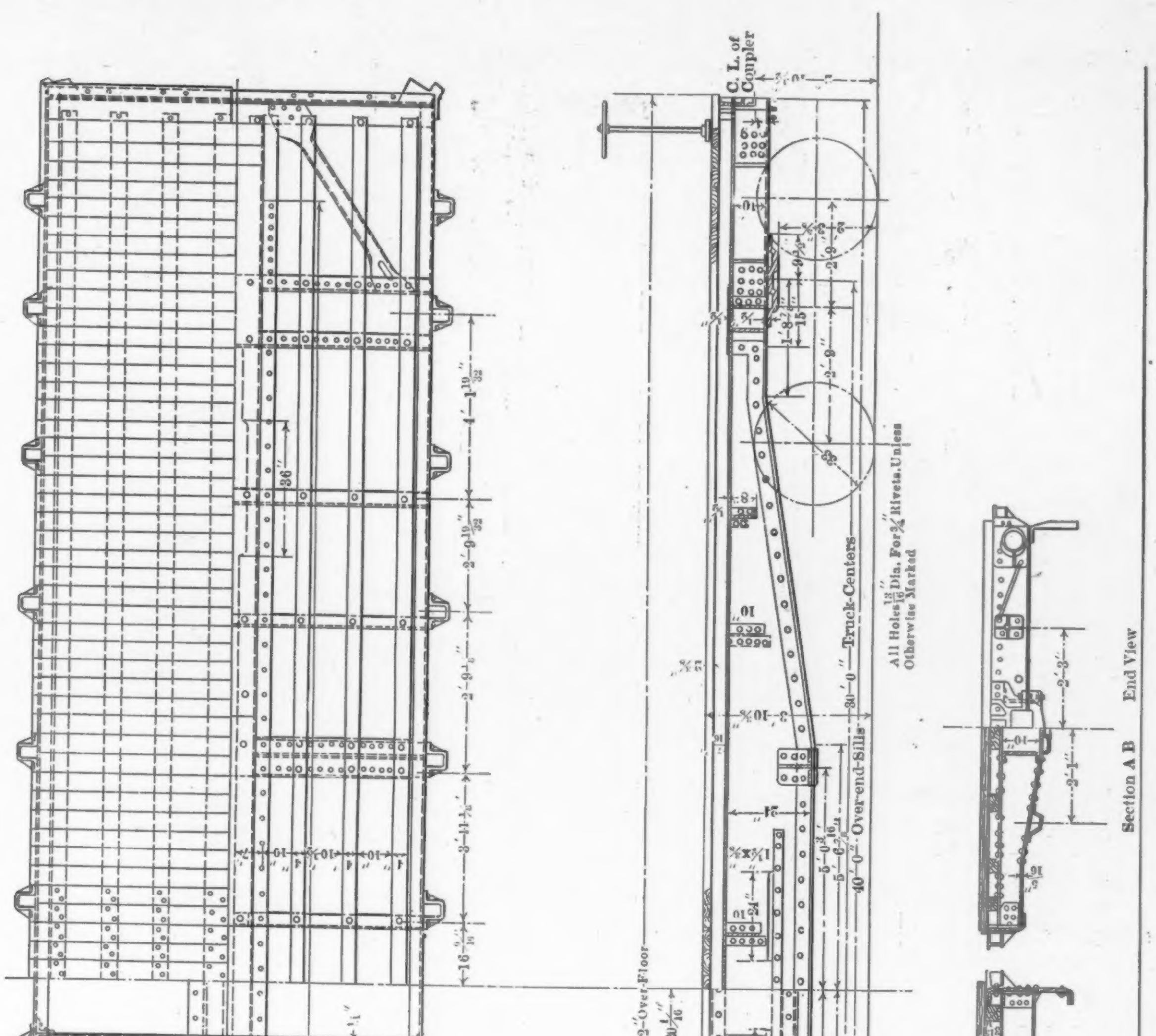
The Fm car has pressed steel center sills 24 ins. deep at the center and 10 ins. deep at the bolsters. These are reinforced by angles at the lower flanges and they are covered with a 21 by ½ in. cover plate, which extends between the bolsters and to a distance of 2 ft. 6 ins. beyond the bolsters at each end. The side sills are also pressed steel channels 24 ins. deep, with their lower and upper flanges reinforced with angles extending between the bolsters. The upper flanges of the side sills are higher than those of the center sills, they turn in just under the flooring while the floor stringers rest upon the cover plate of the center sills at the center of the car. The drawings illustrate the construction of the bolsters, the end sills and the large cross bearers, two of which cross the frame between the bolsters. The cross bearers have 10 by 7-16 in. cover plates. In addition to these the floor is also supported by smaller cross bearers of 10 and 8 in. pressed channels, as indicated in the drawings of the Fm car. In the engravings the section at A-B shows one of the cross bearers and E-F shows a bolster and end sill. The general plan of the frame illustrates the corner bracing and the substantial gussets and cover plates over the bolsters. The Fm car weighs 40,000 lbs. for a capacity of 100,000 lbs.

With a length of 40 ft. and concentrated loads the neutral axis of the sills would be too low and the strength insufficient unless the pressed steel channels were reinforced by angles at the bottom and, in the case of the side sills, angles also at the top and cover plates over the center sills. The side sills of the Fm car are each designed to carry about one-sixth of the total load.

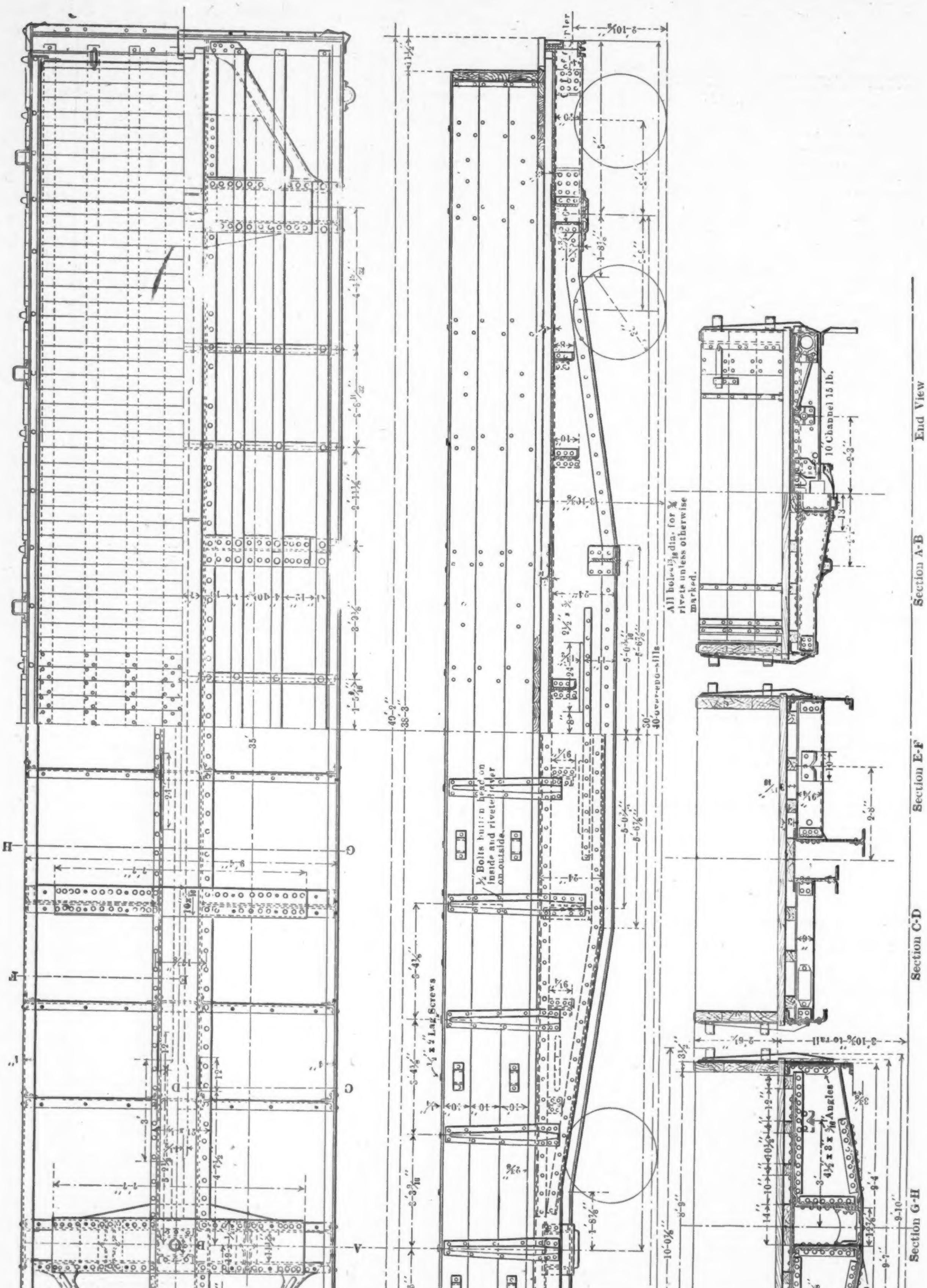
The Gr class, also built for concentrated loads, has steel underframing and wooden gondola sides, with pressed steel stakes. This car is as wide as it could be built and the members of the underframe are generally similar to those of the Fm class. This class is also 40 ft. long. The inside dimensions are 37 ft. 8¼ ins. by 8 ft. 9 ins., and the sides are 30 ins. high.

It is to be noted that the wooden sides are made 3½ ins. thick, and the height limited to 30 ins. This is for the purpose of better adapting the car for carrying top loads of long structural material, the car being primarily designed to serve the steel mill district, where such top loads are becoming more and more frequent and where long loads on top of high sides are objectionable.

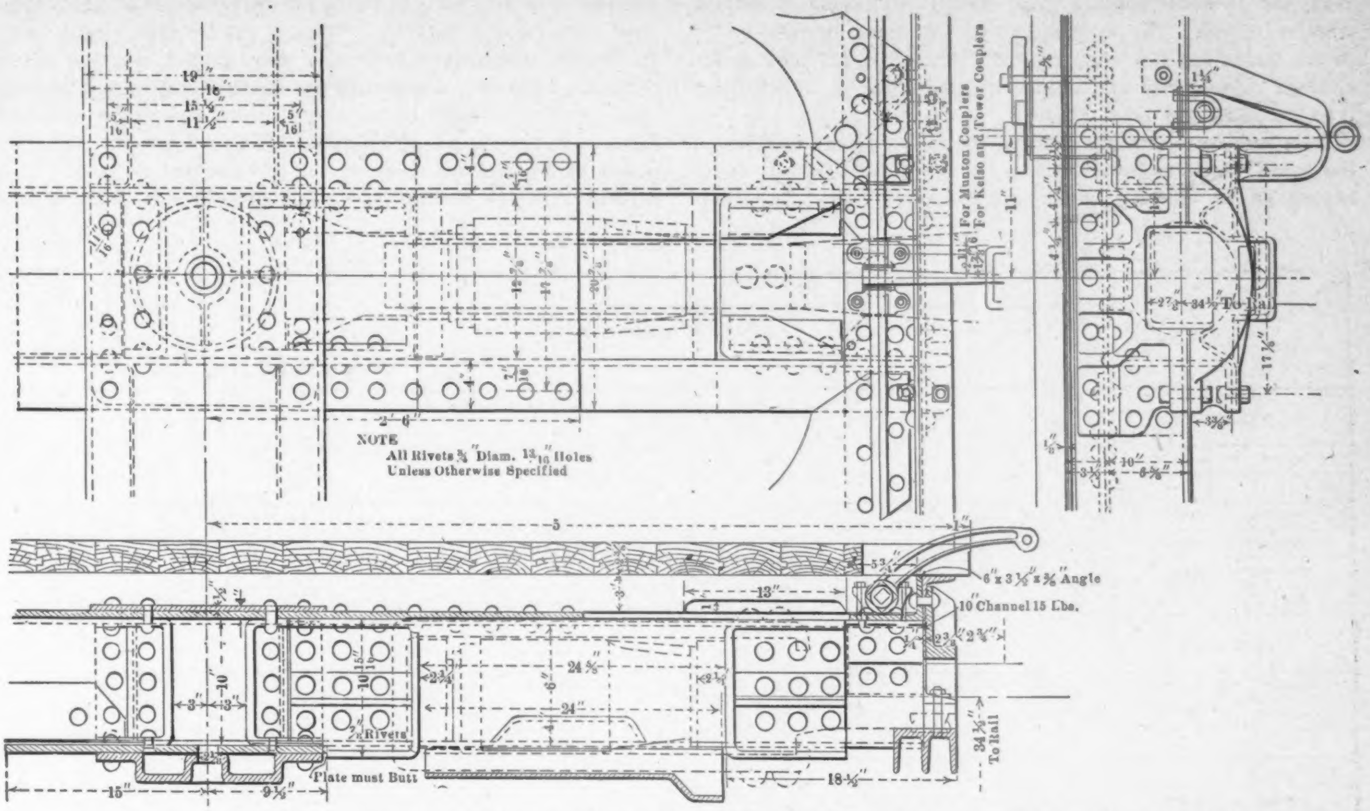
These cars weigh 44,000 lbs. and carry 100,000 lbs., making the ratio of dead weight to paying load 44 per cent. These cars have drop ends. They are fitted with Westinghouse friction draft gear, the arrangement of which is indicated in the detail engraving which applies to both the Gr and the Fm classes. This draft attachment has been found perfectly satisfactory in service on a large number of steel cars.



50-TON STEEL FLAT CAR, CLASS FM—PENNSYLVANIA RAILROAD.



50-TON LOW SIDE GONDOLA CAR, WOODEN SIDES, CLASS GR—PENNSYLVANIA RAILROAD.



APPLICATION OF WESTINGHOUSE FRICTION DRAFT GEAR TO FM AND GR CLASSES—PENNSYLVANIA RAILROAD.

CLASSIFICATION OF LOCOMOTIVES FOR TONNAGE RATING PURPOSES.

MR. J. H. LONIE.

In a paper on "A Standard Locomotive Classification," presented before the Master Mechanics' Association in 1901, Mr. R. P. C. Sanderson suggested stenciling on the cabs the hauling capacity of the locomotive in tons on a straight level track at ten miles per hour, together with a letter suggestive of the type of locomotive in question. As these figures would be too long for current use, and as minute refinement is not necessary, it was suggested that the first two figures, representing hundreds, would be sufficient. Thus, a 10-wheel engine capable of hauling 3,700 tons on a straight level track at ten miles per hour would be stencilled T-37. A modification of this system has been successfully used on the Rock Island System for the convenience of the transportation department in loading engines.

The tractive power of each group of engines on the system was first calculated in even thousand pounds (500 lbs. and over being considered as 1,000, and less than 500 lbs. being disregarded), and the tractive power in thousands was then stencilled on the cab together with a letter indicating the type. These letters were chosen more with reference to easy telegraphing than as suggesting types, and are as follows: Simple engines—8-wheel, B; 10-wheel, D; consolidation, C; Atlantic, A; Pacific, N; Mogul, G; suburban, K; 4-wheel switch, H; 6-wheel switch, J. Compound engines—10-wheel, F; consolidation, Q; Atlantic, W. This is known as the road classification and is entirely independent of the motive power classification. Thus, we have 8-wheel engines, from 10,000 to 19,000 lbs. tractive power, known as road class B-10, B-11, B-12, etc.; 10-wheel engines, road class D-14 to D-31; consolidation engines, road classes C-25 to C-40, etc. It was thought preferable to have the two entirely separate classifications rather than to attempt to combine both in one. It is evident that there may be several groups of engines of the same type and tractive power, but differing from each other in detail and each requiring a separate class for the use of the motive power department in ordering repairs, identifying drawings, etc. The transportation department is not interested in these minor differences, and by combining all engines of the same type and tractive power in one group, the number of road classes is greatly reduced. A combined classification is likely to be cumbersome, a burden to the memory and difficult to introduce on a system already having a motive power classification in regular use, while the road classification can be introduced without disturbing the present state of affairs.

The road classification symbols, when once comprehended, give a relative idea of the type and power of the engine, which is mainly what the transportation people want. If they wish to know the motive power class, size of wheels, or other special information, they may get it from the classification register. If a new engine comes on a division, the transportation officials know its tonnage capacity by its road class, though they may have never seen an engine like it before. Engine numbers may be changed so often that their identity is lost, yet so long as the stenciling on the cab remains unchanged, the engine may be properly rated, and no change is necessary in the tonnage rating sheets. The tonnage rating book for each division (the sheet for the division from St. Joe to Fairbury is reproduced) has the columns headed by Nos. 10, 11, 12, etc., up to the highest tractive power of the engines used on the division. The figures in the vertical columns show the rating over the entire division, and this, of course, corresponds to that of the section having the ruling grade for the division. These books show the normal or first rating only, and ratings for wet or stormy weather, fast stock trains, etc., are taken as a fixed percentage of the first or normal rating and an arbitrary allowance made for empty cars.

In making up the ratings, a table was first prepared showing the hauling capacity in tons for each of the different tractive powers and the different grades beginning at zero and advancing by tenths of one per cent. From this table a second was prepared, showing the hauling capacity behind the tender; by substracting from the numbers in the first the *average* weight of all engines, including the tender, having the same tractive power. As an example, from the first table we find that an engine of 19,000 lbs. tractive power would pull on a 1.3 per cent. grade 595 tons. It was found that there were on the system both 8-wheel engines, road class

B-19, and 10-wheel engines, road class D-19, having 19,000 lbs. tractive power. The average weight of these engines is 100 tons. Deducting 100 tons from 595 tons gives 495 tons as the haulage capacity for all engines in road class 19, of whatever type, on a 1.3 per cent. grade.

It is evident that this method of grouping all engines of the same tractive power together, regardless of type, is an advantage to engines which are relatively light for their service, they may be given a lower road class than their tractive power would indicate. Thus, a Pacific type engine with its tender weighing 334,000 lbs. may have a tractive power of, say, 27,800 lbs., and would ordinarily be classified as road class N-28. It may be, however, that there are 10-wheel engines on the road weighing 250,000 lbs. and having a tractive power of 28,400, and these would be classified as D-28. It is evident that the Pacific type engine would stall with a load

NEBRASKA DIVISION

ST. JOE-FAIRBURY LINE

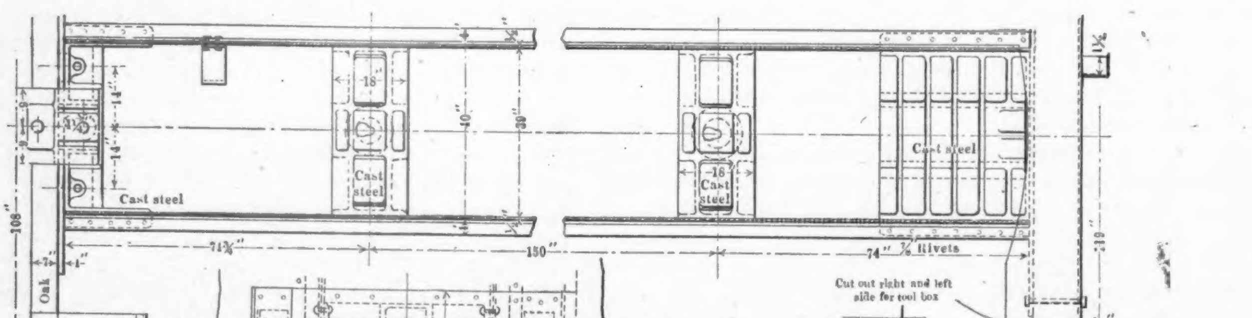
WESTWARD	ROAD CLASS OF ENGINE																				
	39	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12
ST. JOE TO HORTON	1360	1230	1185	1140	1110	1065	1040	995	925	915	870	825	775	740	705	675	615	550	545	505	465
HORTON " VIRGINIA	1335	1050	1010	975	945	910	890	850	785	780	745	705	660	630	600	575	525	495	465	430	395
VIRGINIA " BEATRICE	2630	2070	2000	1930	1870	1800	1740	1675	1575	1535	1470	1395	1320	1250	1195	1135	1055	990	925	860	785
BEATRICE " ELLIS	1395	1100	1060	1020	990	950	930	890	820	815	775	735	690	660	625	605	550	520	475	450	415
ELLIS " FAIRBURY	2275	1795	1735	1670	1620	1560	1515	1450	1360	1330	1270	1210	1140	1085	1030	985	910	855	800	740	685
	1335	1050	1010	975	945	910	890	850	785	780	745	705	660	630	600	575	525	495	465	430	395
EASTWARD																					
FAIRBURY TO DU BOIS	1395	1100	1060	1020	990	950	930	890	820	815	775	735	690	660	625	605	550	520	475	450	415
DU BOIS " HORTON	1395	1100	1065	1020	990	950	930	890	820	815	775	735	690	660	625	605	550	520	475	450	415
	1395	1100	1060	1020	990	950	930	890	820	815	775	735	690	660	625	605	550	520	475	450	415
HORTON " ST. JOE	1610	1265	1220	1175	1140	1100	1070	1025	950	940	895	850	800	765	725	695	640	600	565	520	480

SHEET FROM TONNAGE RATING BOOK—ROCK ISLAND SYSTEM.

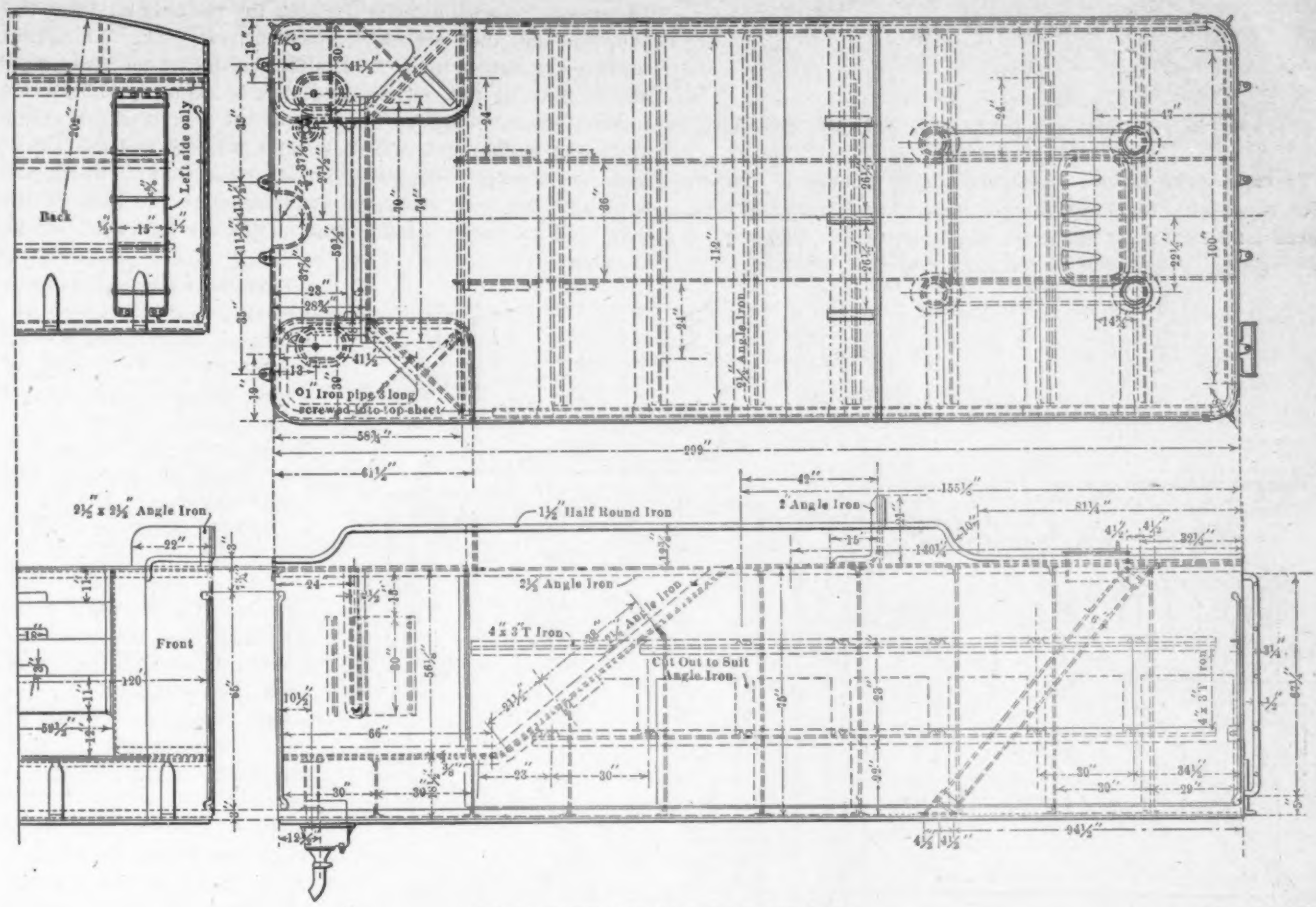
tractive power, while it is a disadvantage to those which are relatively heavy, since the same reduction for weight of engine and tender is made for both, unless the variation of weight is considerable, however, the percentage of error will not be great. Moreover, in getting the average weight of a group, switch engines, which are not ordinarily used to haul trains on the road, and Atlantic and Pacific type engines, which are usually used in passenger service, may be left out of consideration. If Atlantic or Pacific type engines, or other types, with high wheels and small tractive power in proportion to their weight, ordinarily used in passenger service, are to be used in freight service, they may be given a lower road class than their tractive power would indicate. which the 10-wheeler would easily haul, and the Pacific type engine may properly be classed as N-27.

In making up the tonnage rating books, the ruling grade for each section is first determined and the rating for the different classes taken direct from the second table mentioned above. If there are sharp curves on ruling grades the resistance due to the curve may be reduced to its equivalent in percentage of grade.

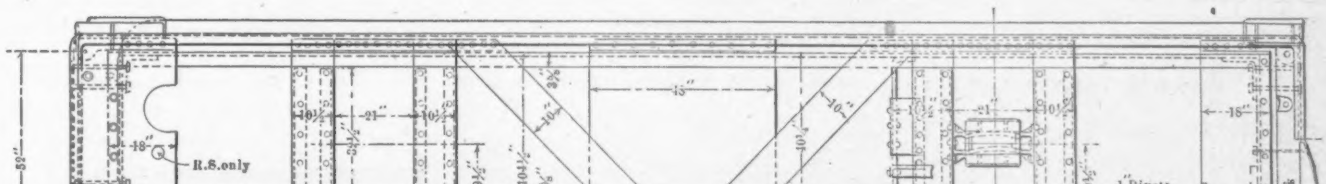
This method of classifying and rating engines is of particular advantage on a system made up of several smaller lines or systems and having a mixed equipment.



FRAME FOR CYLINDRICAL TENDER TANK—HARRIMAN LINES.



TENDER TANK FOR PASSENGER ENGINES.



TENDER FRAME FOR PASSENGER ENGINES.

COMMON STANDARD LOCOMOTIVES—HARRIMAN LINES.

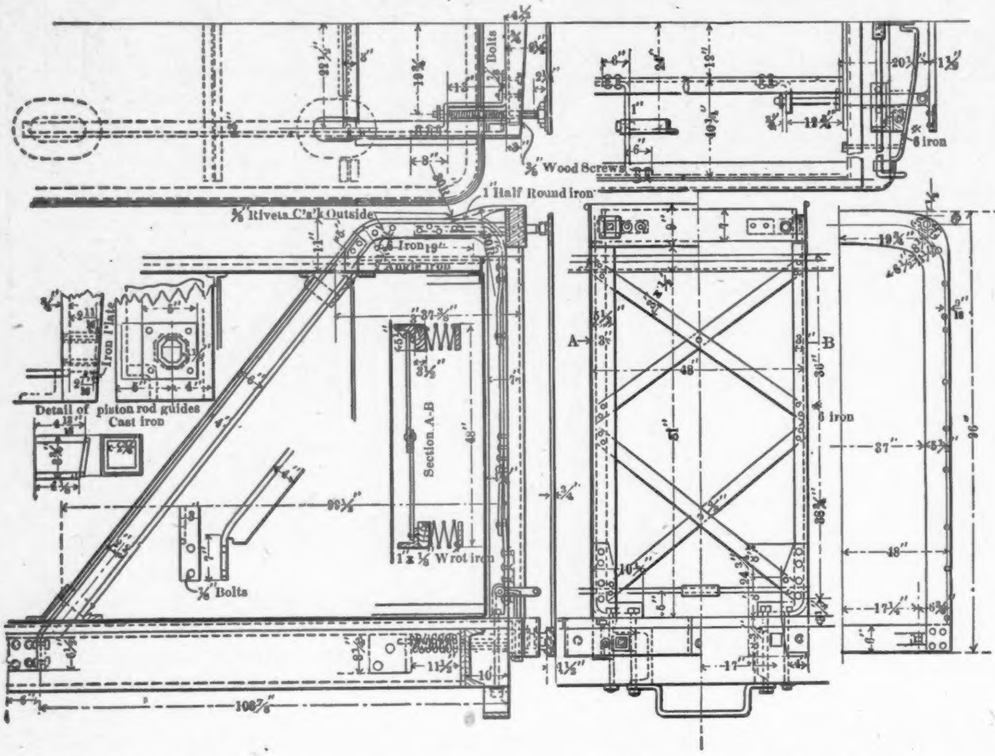
COMMON STANDARD LOCOMOTIVES.

HARRIMAN LINES.

VIII.

(*For previous articles see pages* 154, 200, 250, 288, 322, 353 *and* 400.)

TENDERS.—The freight locomotives have Vanderbilt tenders with a capacity for 7,000 gals. of water and 14 tons of coal. These tenders are frameless as the illustrations indicate. It was originally intended to employ this type of tender for all common standard locomotives except the switching class. In accordance with a latter decision the rectangular form was adopted for the passenger locomotives. The Vanderbilt tenders are built with a ⅜-in. plate, extending the full length of the tank at the bottom, and this is made specially wide to keep riveted joints entirely out of the way of shock of the draft and buffing stresses. Cast steel bolsters and draft castings are secured between ½-in. steel plate sills, which are bent into the form of angles and riveted to the body of the tank and to heavy longitudinal angles, as indicated in the drawing.

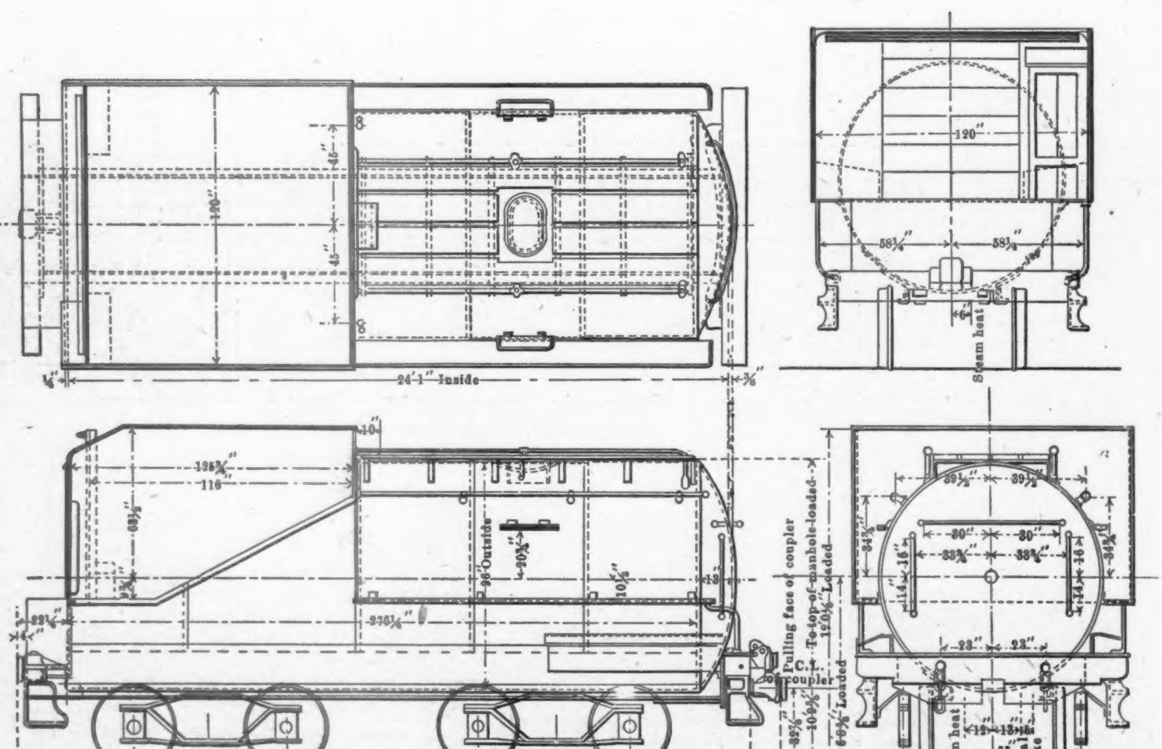


VESTIBULE ARRANGEMENT FOR PASSENGER ENGINE TENDER—HARRIMAN LINES.

TENDERS OF PASSENGERS LOCOMOTIVES.—For passenger service very large tenders with a capacity of 9,000 gals. of water and 10 tons of coal were adopted. These are believed to be the largest tenders used in regular passenger equipment. The frames are of 12-in. channels for side, center and end sills. To the end sills, oak timbers are secured. The framing drawing illustrates the cast steel center plates and the transverse and diagonal bracing plates, which are riveted on top of and beneath the sills. The draft castings are of cast steel.

These tenders are fitted with vestibule diaphragms, the frames of which are rigidly connected to the tender frames and braced by angles in 6-in. pipe passing down through the water in the tank.

The total height of the



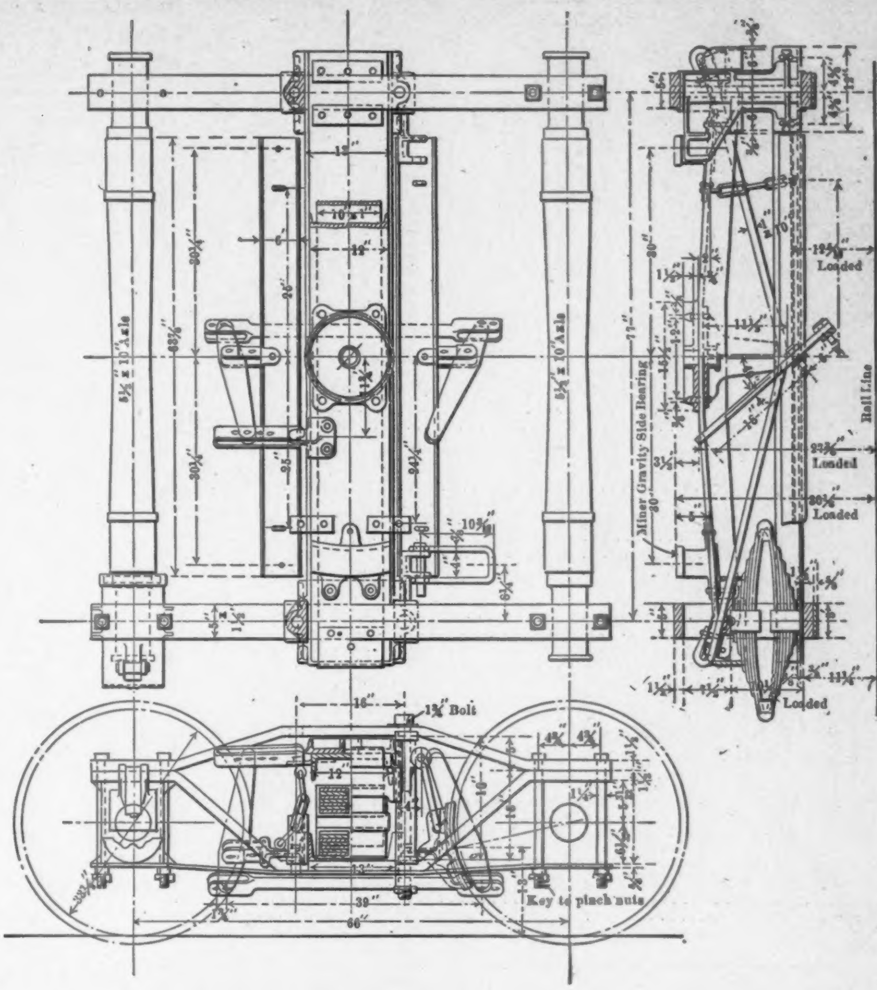
VANDERBILT TENDERS FOR FREIGHT ENGINES—HARRIMAN LINES.

tender over the coal board is 147¾ in. The total height from the rail to the top of the manhole ring is 130 ins. The total wheel base of the tender is 160 ins. The length of the tank is 229 ins. The tank has a water bottom with a depth of 18½ ins. under the coal space in front. At each side liberal tool boxes are provided. The tank bracing is in the form of angles and plates.

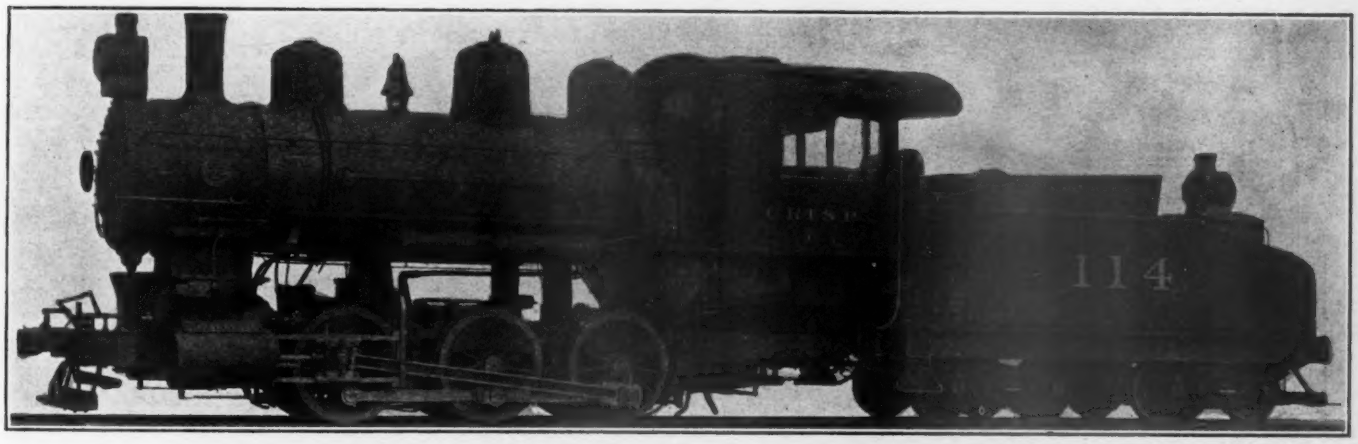
The tenders for the switchers are of ordinary construction with 10-in channel sills, weighing 30 lbs. per ft. The tank slopes towards the rear and the construction is in no way unusual.

TENDER TRUCKS.—These trucks are of the diamond arch bar type with Simplex bolsters. The drawings show the size of the various parts and the channel frames. The trucks for both road and switch engines have inside hung brakes. All road engines 5½ by 10 in. standard M. C. B. tender axles, and the switchers have 4¼ by 8 in. The center plates are of cast steel and M. C. B. contour. The tenders of the switchers have a water capacity of 4,000 gals. and a coal capacity of 5 tons. All of the tenders have Miner gravity side bearings.

The courtesy of Mr. W. V. S. Thorne, director of purchases of the Harriman Lines, in supplying this information is acknowledged, and that of the Baldwin Locomotive Works in supplying the drawings.



TENDER TRUCK FOR FREIGHT ENGINES—HARRIMAN LINES.



SIX-WHEEL SWITCHING LOCOMOTIVE—CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

SIX-WHEEL SWITCHING LOCOMOTIVE.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

The accompanying photograph illustrates one of a number of switching locomotives recently constructed for the Chicago, Rock Island & Pacific Railway at the Richmond works of the American Locomotive Company. Since the presentation of the report of the Power Committee of the Rock Island System a large number of locomotives have been ordered, which, while varying slightly from the detailed dimensions recommended by that committee, follow in general the plan which was presented in outline in this journal in March, page 84. The Baldwin Locomotive Works have built ten switching locomotives, thirty-eight 4—6—0 locomotives with Walschaert valve gear and two 4—4—2 balanced compounds. The American Locomotive Company have built twenty six-wheel switching locomotives, ten 4—4—0 passenger locomotives of which two are supplied with superheaters, twenty 4—6—2 passenger locomotives of which four have superheaters, and fifteen 4—6—0 locomotives for fast freight and passenger service. The Atlantic, Pacific and ten-wheel designs have already been illustrated in this journal, the present description completing the first series built in accordance with the suggestions of the Power Committee. This locomotive has 10¼-in. piston valves with direct valve motion and inside admission. The cylinders are 19 by 26 ins. Driving wheels, 51 ins. in diameter, which, with 200 lbs. boiler pressure, gives a tractive effort of 31,300 lbs. Additional features are presented in the accompanying table.

SIX-WHEEL SWITCHING LOCOMOTIVE—CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

GENERAL DIMENSIONS.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal.
Weight on drivers	138,500 lbs.
Weight in working order	138,500 lbs.
Wheel base, driving	11 ft.
Wheel base, total engine and tender	41 ft. 10 ins.
Total length of engine and tender	57 ft. 9½ ins.

CYLINDERS

Diameter	19 ins.
Piston stroke	26 ins.
Piston packing	Plain rings.
Piston rod diameter......3½ ins. Material	Steel.
Piston rod packing	U. S. metallic.
Steam ports	2⅛ ins.

VALVES.

Style	Piston valve.
Greatest travel	5 21/32 ins.
Lap outside	......
Lap inside	1 in.
Lead in full gear	......

WHEELS.

Driving, number	6
Driving, diameter	51 ins.
Driving centers, material	Cast iron.
Driving box, material	Cast steel.
Driving axle journal	9 ins. by 12 ins.
Crank pin, main	5½ ins. by 6 ins.
Crank pin, side rods	4½ by 3½ and 5 ins. by 4½ ins.

BOILER.

Type	Straight top, wide firebox.
Working pressure	200 lbs.
Outside diameter, first course	62⅛ ins.
Thickness of plates, in barrel	⅝ in.
Thickness of plates	9-16 and ½ in.
Seams, circumferential	Double riveted.
Seams, horizontal	Butt joint, sextuple riveted
Firebox, length	60 ins.
Firebox width	68 ins.
Firebox depth	front, 65½ ins.; back, 56½ ins.
Firebox material	Otis steel.
Firebox plates	sides, ⅜ in.; back, ⅜ in.
Firebox plates	crown, ⅜ in.; tube, ½ in.
Firebox water space	front, 4 ft.; side, 3½ ins.; back, 3½ ins.
Firebox crown stays, radial diameter	1 in.
Firebox staybolts	Ewald and Ulster Special.
Tubes, material	Charcoal iron.
Tubes, length	15 ft.
Tubes, number	237
Tubes, diameter	2 ins.
Tubes, thickness	No. 11.
Heating surface, tubes	1,833 sq. ft
Heating surface, firebox	106 sq. ft
Heating surface, total	1,939 sq. ft.
Grate, style	Rocking, 2 sections.
Grate area	28 sq. ft.
Exhaust pipe, style	Single.
Exhaust pipe, nozzle	4¾ ins., 4⅞ ins. and 5 ins.
Smokestack, inside diameter	15 ins. and 17⅛ ins.
Feed water supplied by	2 Nathan No. 9 Simplex.

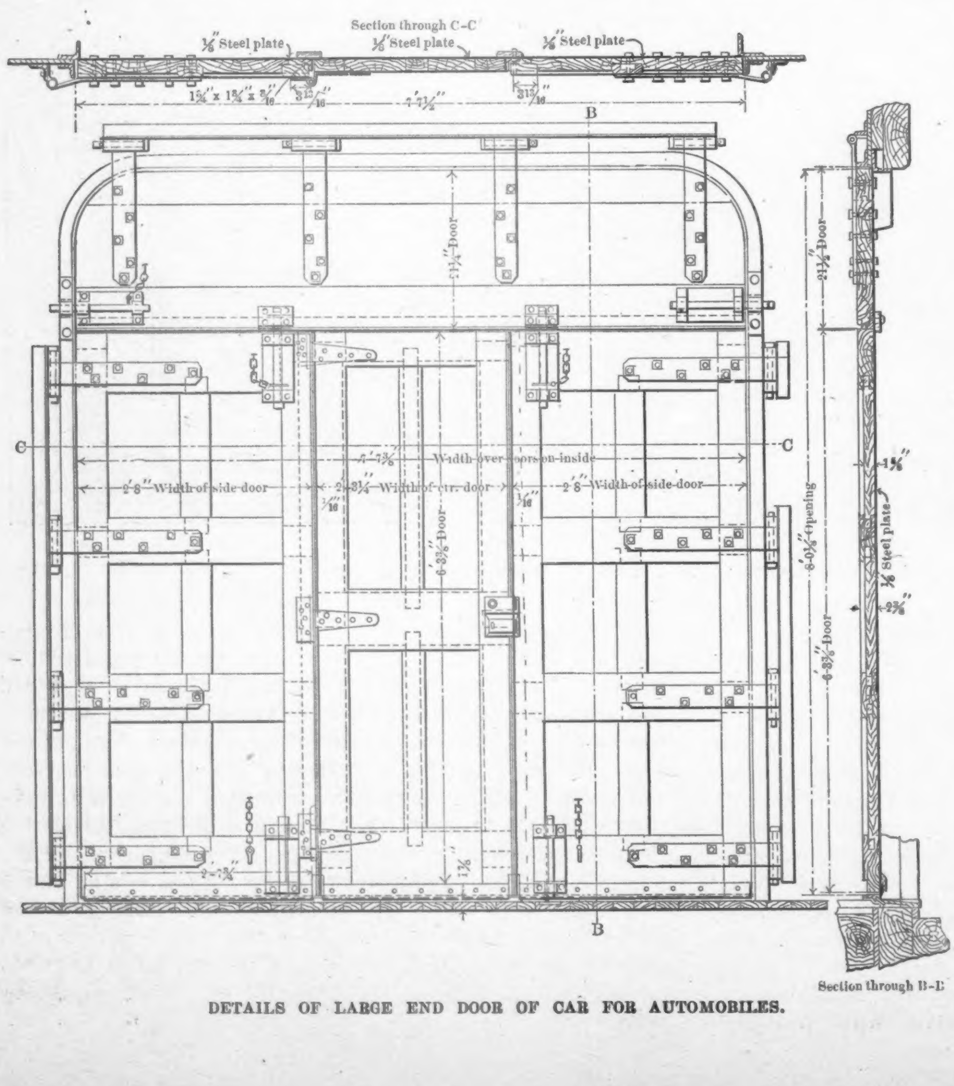
TENDER.

Weight, empty	41,600 lbs.
Frame	13 in. channels
Wheels, number	8
Wheels, diameter	33 ins.
Journals	4¼ ins. by 8 ins.
Wheel base	16 ft.
Tank capacity, water	6,000 gals.
Tank capacity, coal	7 tons.

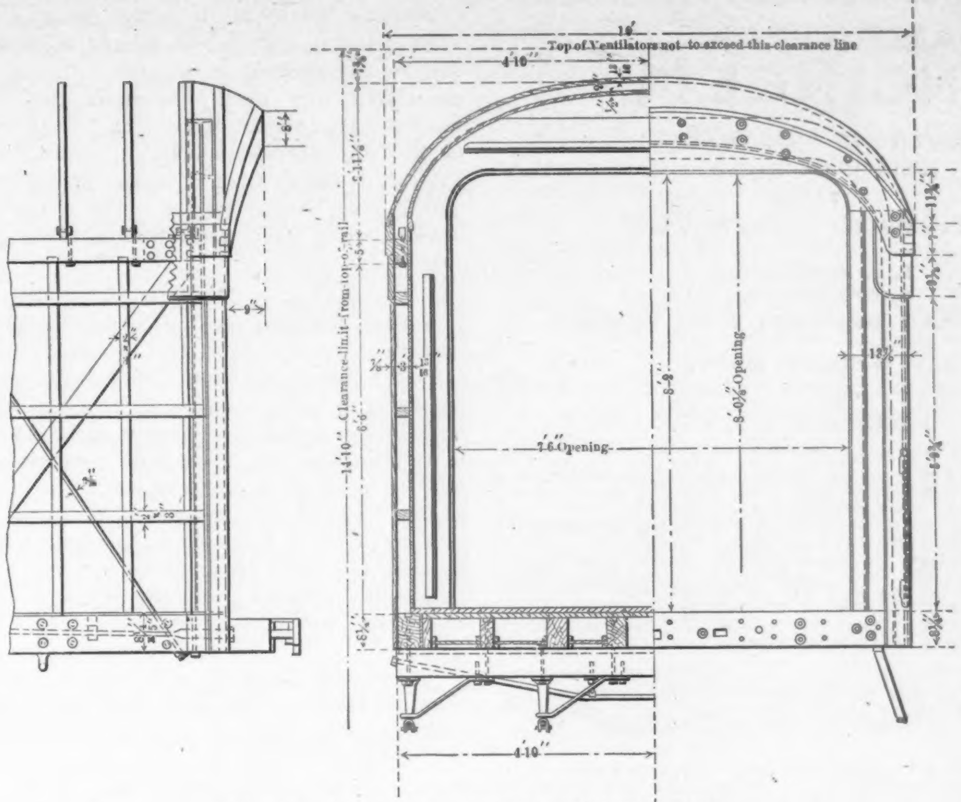
BAGGAGE CAR FOR AUTOMOBILES.

The New York Central recently built at their West Albany shops two baggage cars, to be used for transporting automobiles. The floor and side framing is similar to that of their standard baggage cars, but the roof and end framing has been changed considerably because of the necessity of providing a large opening at one end of the car, through which the automobiles may be loaded. The car is 60 ft. 10 in. long over the end sills, 10 ft. wide over the eaves, and 14 ft. 3½ in. from the rail to the top of the roof. It has two door openings on each side, one 8 ft. and the other 4 ft. 6 in. wide, and both 6 ft. 5½ in. high. The location of these doors is reversed on opposite sides. One end of the car is fitted with a standard end door, while the other end has a door opening 7 ft. 6 in. wide and 8 ft. ⅛ in. high. To use a door of this height, it was necessary to do away with the clere-story type of roof and to use a round top roof, as shown on the drawings. In addition to providing more head room, this roof is simpler and stronger than the clere-story type. In place of the deck sash, 6-in. globe ventilators are used.

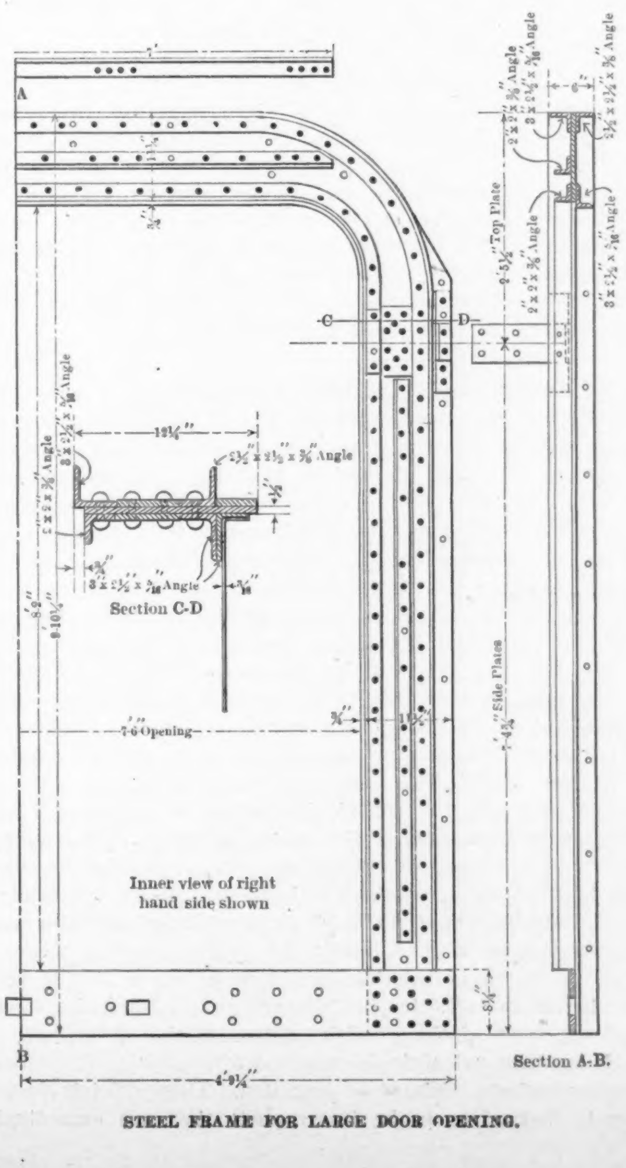
The large end door is made in four sections, as shown in the drawing, and for ordinary purposes the middle section, which is about the same size as the standard end door, may be used. Two of these sections swing to one side, one of them swings to the other side, and the upper part, which extends the full width of the opening, swings up to the roof. The hinges are so arranged that when the doors are swung back, the full size of the door opening is available. To compensate for the reduction in the strength of the end, due to the large opening, the door frame consists of a half-inch steel plate, which extends from the under-framing, up each side and across the top in the form of a flat arch. Angles are riveted to both edges of this plate, and it is otherwise stiffened, as shown in the detail drawing. A half-inch plate, 8¼ in. wide, ties the two ends together at the bottom. The roof is supported by 2 x 2 in. wood carlins, which are fastened to the side framing by means of strap bolts extending through the side plates. At intervals of 5 ft. 6 in., iron carlins are used, to which nailing blocks are fastened with ⅜ in. bolts. Four-wheel trucks are used. We are indebted to Mr. F. M. Whyte, general mechanical engineer, for information and drawings.



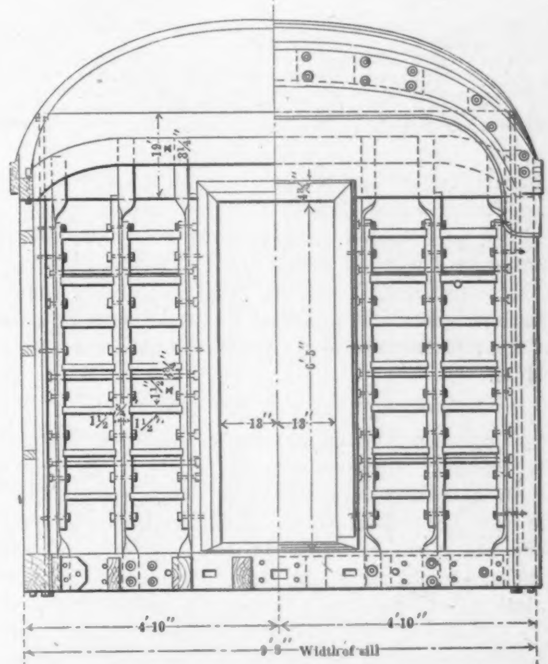
DETAILS OF LARGE END DOOR OF CAR FOR AUTOMOBILES.



CONSTRUCTION OF END HAVING LARGE DOOR OPENING.



STEEL FRAME FOR LARGE DOOR OPENING.



FRAMING OF END OF THE CAR HAVING SMALL DOOR OPENING.

Shop Officials Should Know the Cost of Work.—I know from personal experience that where the cost of work on locomotives has been promptly furnished to the master mechanic and general foreman, and also distributed so as to give the foreman of the boiler shop, the blacksmith shop, the tin shop, the carpenter shop, machine shop, erecting shop and all sub-departments their proportion of the labor and material, it has often impressed them with the high cost of their part of the work and has stimulated them to keep down expenses in their department, thereby saving large sums of money to the railroad company. The effect of such information is much lessened when it is three or four months old. It ought to be furnished within 20 days after the end of the month, so that the work done on the engine will be clear in the minds of the men who supervised it.—*Mr. M. K. Barnum, before the Western Railway Club.*

(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE.

J. S. BONSALL,
Business Manager.

140 NASSAU STREET, NEW YORK.

R. V. WRIGHT, Editor.

DECEMBER, 1905.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union. Remit by Express Money Order, Draft or Post Office Order.*
Subscription for this paper will be received and copies kept for sale by the
Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburgh, Pa.
Century News Co., 6 Third St. S., Minneapolis, Minn.
Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., London, England.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.*
When a subscriber changes his address *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

English locomotive people are not a little troubled with the spark problem. English locomotives, as a rule, have no device for catching or pulverizing sparks. A motive power official of a leading road recently remarked that it was perfectly easy to stop sparks throwing, but he could not at the same time make engines steam. This seems to throw some light on the effect of the free front ends upon the high efficiency of English locomotives.

A very important and noticeable feature in connection with the most recently designed machine tools is the centralization of all operating levers so that every operation of the machine can be controlled by the attendant without moving from his position. This is not only true of variable speed motor driven tools, but is also true of those having mechanical speed changes, although in several cases a considerable number of mechanical changes have been provided. With machine tools as convenient as these and made "fool proof," as most of them are, the records which are being made in some of the recently equipped railroad machine shops are not at all surprising.

An important feature of the balanced compound locomotive, which has not received the attention which its importance deserves, is the small longitudinal disturbing forces as compared with those in a single expansion locomotive. The excessive longitudinal forces in a single expansion locomotive running at a high rate of speed are undoubtedly largely responsible for the many frame and cylinder breakages of recent years, and it is quite reasonable to expect that the cost of maintenance of these parts, as well as others which are indirectly subjected to these forces, will be considerably reduced, due to the introduction of the balanced compound system. The results of Mr. Coster's investigation are worthy of careful thought and study.

On a system where a large number of types and classes of locomotives are in use it is important, in order that the tonnage rating system may be used to the best advantage, that a simple classification be adopted so that the transportation department may readily determine just what rating a particular engine should carry, even though they had never seen or had any experience with it before. A very simple and successful classification is in use on the Rock Island System, and is based on the tractive power of the engine. A detailed description of this system will be found on another page of this issue.

A large machine tool recently installed in a certain railroad shop, and costing several thousand dollars, forms a rather imposing monument to a lack of proper care in the selection of machine tools by those in charge. The tool cost about the same and weighs somewhat more than a similar tool in a nearby shop, but it can only turn out a little more than half as much work, and this is due to no fault on the part of the operator, but because of the poor design and a lack of certain improvements. A photograph, a skillfully worded specification and a sharp salesman were the arguments which caused the railroad company to invest in the tool. Something more than this is necessary.

In studying the work of a motive power official who has been remarkably successful, one feature which has undoubtedly contributed largely to his success is especially noticeable. If a subordinate makes a mistake, or is not getting the results expected of him, this officer, instead of finding fault, and thus discouraging the man, takes the matter up with him in a kindly but firm manner, explains the seriousness of the fault, and then makes suggestions as to how conditions may be improved, and talks the matter over with him in an intelligent and friendly spirit. While the man is made to fully realize the seriousness of his fault, he is at the same time encouraged to do better, and is given some cue as to how better results may be obtained. Continual fault finding tends to cause a man to lose his self-respect and to paralyze his energies. Directing attention to errors or weak spots and at the same time intelligently coaching the man to do better causes him to put forth his best efforts, and greatly increases his earning capacity. It has been said that the head of the motive power department is paid to criticize, but his criticism should be constructive, not destructive.

The English way of receiving a railroad supply man visiting motive power officials in the line of his business was recently described to the writer, by one who has been very successful in securing "results" in England. This method presents many good points and is worthy of consideration on this side of the water. This gentleman said "In the first place letters of introduction are necessary in England. At the outset I adopted the plan of writing to the official I wanted to see, stating that I had letters of introduction, requesting the privilege of presenting them, and asking for an appointment. This was put in diplomatic language and I also stated my purpose, putting this in a language which would show him that I would not waste a moment of his time. My subject interested these gentlemen and in every case an appointment was made. The call was invariably punctual to the appointment and the official always had all the papers and information pertaining to the subject of my interview on his table and was ready at once to proceed. It is absolutely useless in England, or on the Continent, to call upon a railway official without the formality of an appointment and the mere presentation of a card causes the porter or chief clerk to loom up as an obstruction as big as a house. He is both formidable and effective in this capacity. I have also found that the word of the English railway official is as good as their bond, in not a single case was a promise to investigate or communicate, violated or forgotten. These officials do not permit themselves to be interrupted; they are exceedingly

jealous of their time, and while the office hours are relatively short their work is intense and systematic. I found it necessary to first understand and then follow the methods of this country and have learned to regard them with favor."

THE BOILER SHOP FOR COLLEGE MEN.

Editors would be able to set forth many more good ideas if people who are in direct contact with the problems would occasionally forget to say: "Not for publication."

In vigorous sentences a correspondent discusses the need of leadership talent in the boiler shop, and deplores the tendency for young men who are looking for advancement to pass by this department. His letter ought to be printed. It shows how young men desiring opportunities want to get into the machine shop, where many of them begin and end. If some of them would enter the boiler shop they could fit themselves to earn from $125 to $200 per month in as short a time as it can be done anywhere, providing they are qualified to direct the work of other men. A few bright young men would attract attention to this department and assist in securing a better grade of men who are looking for advancement. Boiler work is hard, noisy and disagreeable. A good physique is required, but what becomes of the muscle developed on the "gridiron?" Boiler work would keep this muscle in good condition, and if a young man is successful in the boiler shop he has made an excellent start in his career.

It is evident that the boiler shop is to-day in need of improvement and of men. Here is where good men will be able to show their value quickly and for this reason this shop ought to be attractive to the young men entering railroad work from the colleges. It offers a better opportunity at present than any other shop department.

GRAPHICAL RECORDS.

The heads of at least two of the railroad motive power departments in America carry with them notebooks, in which a large number of records pertaining to their departments, and extending over a considerable period of time, are plotted graphically. If they are called into the general manager's office for consultation, or are accompanying their superior officers on a trip, they can, at a moment's notice, supply detail information concerning almost any important feature connected with their department. They can also readily see just how various items are affecting the operation, and can readily follow the work of their subordinate officers and locate weak spots. A few weeks ago, while in the office of one of these men, a shop superintendent was asked for certain information concerning the output of the shop and the effect of certain improvements which had been introduced. He took from his pocket one of these notebooks containing a number of diagrams, and showed clearly and forcibly inside of three or four minutes just what results were being obtained. To have conveyed the same information by the use of figures alone would have consumed a considerable longer time, and it is very doubtful if, even under favorable circumstances, they would have conveyed half as clear or forcible an idea of what had been accomplished. There is not much satisfaction in wading through a mass of figures or statistics, but if they are plotted out graphically their relative importance can be grasped almost instantly. On another page of this issue is an article concerning the practical use of these diagrams. The expense of maintaining such records is comparatively slight, and when it is considered that they save much of the motive power official's time and give him a very clear and forcible idea of what his department is doing, and thus add very greatly to his efficiency, it is surprising that they are not more generally used.

The article by Mr. Larsen shows several applications of this system to mechanical department records and suggests a number of items which can be treated in this way with satisfactory results.

COMPARATIVE MAGNITUDE OF LONGITUDINAL DISTURBING FORCES IN A COLE BALANCED COMPOUND AND A SINGLE EXPANSION EXPRESS LOCOMOTIVE.

BY EDWARD L. COSTER, ASSOC. AM. SOC. M. E.

Since little definite information has yet been published upon the subject of the comparative magnitude of the longitudinal disturbing forces in the four-cylinder balanced, and the ordinary two-crank locomotive, I beg to submit the following analysis of the relative horizontal inertia effects in a recent 4—4—2 type, Cole balanced compound locomotive, and a very carefully designed single-expansion locomotive of the same type, and of approximately equal power; the particulars of both engines having been kindly supplied me by the builders.

TABLE I. PARTICULARS OF LOCOMOTIVES.

Class of locomotive	Cole Bal. Compound.	Single Expansion.
Diameter of H. P. cylinders	16 in.	22 in.
Diameter of L. P. cylinders	27 in.	......
Piston stroke	26 in.	26 in.
Driving wheel diameter	80 in.	80 in.
Working steam pressure	205 lb. per sq. in.	205 lb. per sq. in.
Weight of locomotive, empty	178,600 lb.	163,100 lb.
Weight of locomotive in working order	200,500 lb.	183,100 lb.
Adhesive weight, in working order	117,200 lb.	118,200 lb.
Maximum tractive force, operating compound	23,300 lb.	With M. E. P.= 0.85 boiler pressure.
Maximum tractive force, with direct admission to L. P. cylinders	27,600 lb.	27,409 lb.
Weight of H. P. piston, piston rod and key, crosshead and pin, complete	581 lb.	683 lb.
Weight of L. P. piston, piston rod and key, crosshead and pin, complete	598 lb.	......
Weight of H. P. connecting rod, front end	146 lb.	255 lb.
Weight of H. P. connecting rod, back end	354 lb.	403.5 lb.
Weight of H. P. connecting rod, total	500 lb.	658.5 lb.
Weight of L. P. connecting rod, front end	189 lb.	......
Weight of L. P. connecting rod, back end	399 lb.	......
Weight of L. P. connecting rod, total	588 lb.	......
Length of H. P. connecting rod	101 in.= 8.417 ft.	135⅞ in.=11.323 ft.
Length of L. P. connecting rod	130 in.= 10.833 ft.	......
Distance of center of gravity of H. P. connecting rod from crank-pin center	29.492 in.= 2.458 ft.	52.617 in.=4.385 ft.
Distance of center of gravity of L. P. connecting rod from crank-pin center	41.786 in.= 3.482 ft.	......
Crank radius	13 in.= 1.08 ft.	13 in.=1.08 ft.

Disregarding the effects of steam action, to determine the forces exerted on the main crank-pin by the inertia of the reciprocating parts and the connecting rod at the ends of the stroke:

Let G = weight of reciprocating parts in pounds.
G' = weight of connecting rod in pounds.
l = length of connecting rod in feet.
d = distance of center of gravity of connecting rod from crank-pin center in feet.
r = crank radius in feet.
s = piston stroke in inches.
P_F = inertia of reciprocating parts at front dead center in pounds.
P_B = inertia of reciprocating parts at back dead center in pounds.
P'_F = horizontal inertia of connecting rod at front dead center in pounds.
P'_B = horizontal inertia of connecting rod at back dead center in pounds.
C = centrifugal force of connecting rod at both dead centers in pounds.

Then, as demonstrated in Henderson's "Locomotive Operation" (pp. 26-31 and 39-40), for a translational velocity in miles per hour equal to the driving-wheel diameter in inches, we have:

$$P_F = 1.6\ G\ s \left[1 + \frac{r}{l}\right]$$

$$P_B = 1.6\ G\ s \left[1 - \frac{r}{l}\right]$$

$$P'_F - C = 1.6\ G'\ s \left[1 + \frac{2dr - rl}{l^2}\right]$$

$$P'_B + C = 1.6\ G'\ s \left[1 - \frac{2dr - rl}{l^2}\right]$$

Introducing into these equations the values given in the above table for the locomotives under consideration, then at 80 m.p.h., the stresses on the main crank-pins at the dead points, due to the inertia of the reciprocating parts and the connecting rod, are as follows:

COLE BALANCED COMPOUND LOCOMOTIVE.

For the H.P. reciprocating parts

$$P_F = 1.6 \times 581 \times 26 \left[1 + \frac{1.08}{8.417}\right] = 24{,}169.6 \times 1.12831 = 27{,}270.8 \text{ lb.}$$

$$P_B = 24{,}169.6\ [1 - 0.12831] = 24{,}169.6 \times 0.87169 = 21{,}068.4 \text{ lb.}$$

For the H.P. connecting rod

$$P'_F - C = 1.6 \times 500 \times 26 \left[1 + \frac{2 \times 2.458 \times 1.08 - 1.08 \times 8.417}{8.417^2}\right]$$

$$= 20{,}800 \left[1 + \frac{-3.78108}{70.846}\right]$$

$$= 20{,}800\ [1 + (-0.05337)] = 20{,}800 \times 0.94663 = 19{,}689.9 \text{ lb.}$$

$$P'_B + C = 20{,}800\ [1 - (-0.05337)] = 20{,}800 \times 1.05337 = 21{,}910.1 \text{ lb.}$$

Hence the net horizontal inertia forces on the H.P. crank-pin are:

At the front dead center,

$$P_F + (P'_F - C) = 27{,}270.8 + 19{,}689.9 = 46{,}960.7 \text{ lb.}$$

At the back dead center,

$$P_B + P'_B + C = 21{,}068.4 + 21{,}910.1 = 42{,}978.5 \text{ lb.}$$

For the L.P. reciprocating parts

$$P_F = 1.6 \times 598 \times 26 \left[1 + \frac{1.08}{10.833}\right] = 24{,}876.8 \times 1.09969 = 27{,}356.8 \text{ lb.}$$

$$P_B = 24{,}876.8\ [1 - 0.09969] = 24{,}876.8 \times 0.90031 = 22{,}396.8 \text{ lb.}$$

For the L.P. connecting rod

$$P'_F - C = 1.6 \times 588 \times 26 \left[1 + \frac{2 \times 3.482 \times 1.08 - 1.08 \times 10.833}{10.833^2}\right]$$

$$= 24{,}460.8 \left[1 + \frac{-4.17852}{117.354}\right]$$

$$= 24{,}460.8\ [1 + (-0.03561)] = 24{,}460.8 \times 0.96439 = 23{,}589.7 \text{ lb}$$

$$P'_B + C = 24{,}460.8\ [1 - (-0.03561)] = 24{,}460.8 \times 1.03561 = 25{,}331.8 \text{ lb}$$

Hence the net horizontal inertia forces on the L.P. crank-pin are:

At the front dead center,

$$P_F + (P'_F - C) = 27{,}356.8 + 23{,}589.7 = 50{,}946.5 \text{ lb.}$$

At the back dead center,

$$P_B + P'_B + C = 22{,}396.8 + 25{,}331.8 = 47{,}728.6 \text{ lb.}$$

Consequently, the effect upon the locomotive as a whole is as follows:

With the H.P. crank at the front center and the L.P crank at the back center, the resulting longitudinal disturbing force is

47,728.6—46,960.7=767.9 lb., acting backward.

With the H.P. crank at the back center and the L.P. crank at the front center, the unbalanced force is

50,946.5—42,978.5=7,968 lb., acting forward.

The total variation per semi-revolution being,

767.9+7,968=8,735.9 lb.

SINGLE-EXPANSION LOCOMOTIVE.

For the reciprocating parts

$$P_F = 1.6 \times 683 \times 26 \left[1 + \frac{1.08}{11.323}\right] = 28{,}412.8 \times 1.09538 = 31{,}122.8 \text{ lb.}$$

$$P_B = 28{,}412.8\ [1 - 0.09538] = 28{,}412.8 \times 0.90462 = 25{,}702.8 \text{ lb.}$$

For the connecting rod

$$P'_F - C = 1.6 \times 658.5 \times 26 \left[1 + \frac{2 \times 4.385 \times 1.08 - 1.08 \times 11.323}{11.323^2}\right]$$

$$= 27{,}393.6 \left[1 + \frac{-2.75724}{128.21}\right]$$

$$= 27{,}393.6\ [1 + (-0.0215)] = 27{,}393.6 \times 0.9785 = 26{,}804.6 \text{ lb.}$$

$$P'_B + C = 27{,}393.6\ [1 - (-0.0215)] = 27{,}393.6 \times 1.0215 = 27{,}982.6 \text{ lb.}$$

Hence the net horizontal inertia forces on the main crank-pin, or the longitudinal disturbing effects upon the locomotive as a whole are:

At the front dead center,

$P_F + (P'_F - C) = 31{,}122.8 + 26{,}804.6 = 57{,}927.4$ lb., acting forward.

At the back dead center,

$P_B + P'_B + C = 25{,}702.8 + 27{,}982.6 = 53{,}685.4$ lb., acting backward.

The total variation per semi-revolution being,

57,927.4+53,685.4=111,612.8 lb.

The foregoing results are summarized in the following table:

TABLE II. INERTIA OF RECIPROCATING PARTS AND CONNECTING ROD AT 80 M.P.H., OR 336 R.P.M.

	Cole Balanced Compound.	Single Expansion.	Decrease of Inertia Force in Balanced Compound.
Inertia force on H. P. crank-pin at front center	46,960.7 lb.	57,927.4 lb.	10,966.7 lb.
Inertia force on H. P. crank-pin at back center	42,978.5 lb.	53,685.4 lb.	10,706.9 lb.
Inertia force on L. P. crank-pin at front center	50,946.5 lb.	......	......
Inertia force on L. P. crank-pin at back center	47,728.6 lb.	......	......
Inertia force on locomotive as a whole, H. P. crank-pin at front center	B.767.9 lb.	57,927.4 lb.	57,159.5 lb.
Inertia force on locomotive as a whole, H. P. crank-pin at back center	F.7,968.0 lb.	53,685.4 lb.	45,717.4 lb.
Inertia force, total variation per semi-revolution	8,735.9 lb.	111,612.8 lb.	102,876.9 lb.

Now, as stated by Prof. William Ripper, in his "Steam-Engine Theory and Practice" (p. 278), "The effect of compression or cushioning of the steam in the cylinder during the retardation of the reciprocating parts is to remove the retarding force (acting as driving force) from the crank-pin and transfer it to the cylinder, where we now have, however, the same net result on the engine frame, only the stress is applied to the cylinder-cover instead of to the crank-pin."

It is therefore suggested that the figures presented in the above table may possibly indicate one of the causes which have produced so many cylinder and frame breakages in this country, as they show that in the case of the single-expansion locomotive when at 80 m.p.h., forces of 28.96 and 26.84 tons, are required to overcome the horizontal inertia of the reciprocating parts and the connecting rod at the front and back dead centers, respectively.

The machinery of this engine represents a high degree of lightness and refinement of design, hence it is evident that the great comparative reduction of the longitudinal inertia forces obtained in the four-cylinder balanced locomotive, as given in the last column of the table, constitutes an important advantage of this type of engine for heavy fast passenger service.

The two new Cunard liners which are being built in Scotland will each be equipped with four steam turbines, each designed for an indicated horse-power of 18,000.

CAST STEEL LOCOMOTIVE CYLINDER.—The first open hearth cast steel locomotive cylinder produced in this country was recently made for the New York Central by the Pennsylvania Steel Casting & Machine Company, Chester, Pa. It is said that from 15 to 20 per cent. in weight may be saved by this method. These cylinders are stronger than those made of cast iron, and were tested to a hydrostatic pressure of 600 lbs. per sq. in.

FIG. 2.—MILLING DRIVING BOX FACE OF SHOES AND WEDGES.

FIG. 3.—MILLING OUTSIDES AND TOPS OF THE FLANGES OF SHOES AND WEDGES.

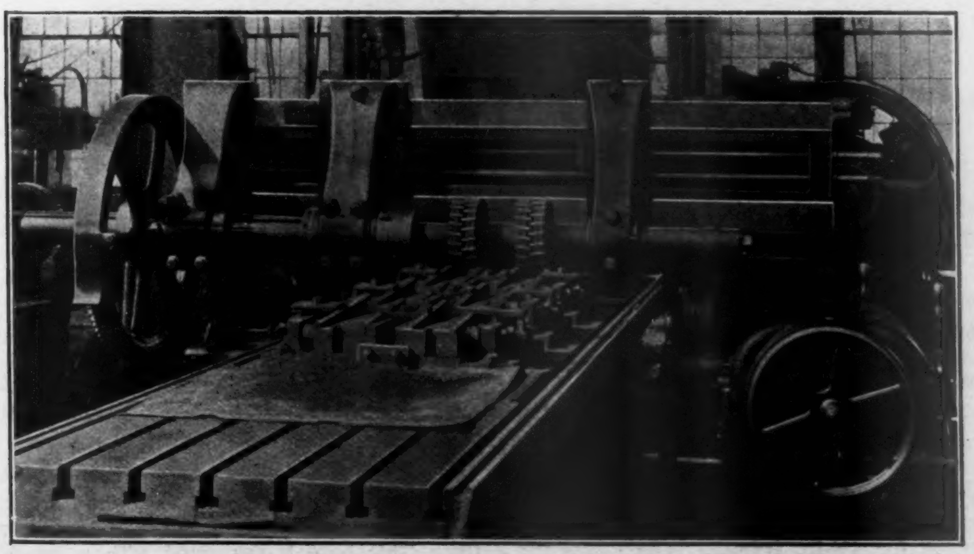


FIG. 4.—FINISHING THE INSIDE SURFACES OF SHOES AND WEDGES.

PRODUCTION IMPROVEMENTS.

MILLING CASTINGS AT THE ANGUS SHOPS.

On page 406 of our November journal we described the milling of cast iron and cast steel driving boxes at the Angus shops of the Canadian Pacific Railway. In addition to milling the driving boxes they are having considerable success in milling other castings, including engine truck boxes, shoes and wedges and cast steel crosshead shoes. To handle this work to advantage, it is, of course, advisable to run the different castings through in fairly large quantities, so that as little time as possible will be lost in changing the jigs and tools. It is also advisable to have as many rows of castings as the width and the power of the machine will permit, as the cutting time is the same for two or more rows as for one. While the cost of the milling cutters, which are of high speed steel, is rather high yet when we consider that often several faces are finished by one tool at the same time, and that the castings are roughed and finished with one cut, it can readily be seen that the cost of the cutters may be saved in a short time. The milling cutters are made at the Angus shops and are easily kept sharp and in good condition, a Landis grinding machine being provided for this purpose. The machine upon which the work is done is a 48 in. Bement-Miles & Company motor driven horizontal miller.

ENGINE TRUCK BOXES.

The engine truck boxes are handled in practically the same manner as the driving boxes. The sides are first milled with an inserted tooth cutter 8 ins. in diameter and 30 ins. long; a long double knee or angle plate is then placed on the table of the machine and a row of boxes is bolted on each side of this plate the full length of the table; the two sets of adjustable, plate cutters, which are 12 ins. in diameter (the same as used for the driving boxes and shown in Fig. 2, page 406), are then placed on the arbor and adjusted for the proper width of the engine truck pedestal jaws, and the boxes are finished in the same manner as the driving boxes.

SHOES AND WEDGES.

In milling the shoes and wedges the jig shown in Fig. 1 is used. At the present time

only three of these jigs have been constructed, and, thus only six shoes are milled at one time. The driving box face is first milled as shown in Fig. 2. The cutter is of the inserted tooth type, 8 ins. in diameter and 18 ins. long, and operates at 12½ r.p.m. with a table feed of 2¾ ins. per min. After the first operation the jigs are removed from the table and two rows of shoes or wedges of six each are placed upon parallel strips and are securely held in place by the clamps and T bolts, as shown in Fig. 3. The outsides and the tops of the flanges are milled by the gang cutters. The large cutters are of the inserted-plate type, 13 ins. in diameter, while the small cutters are solid and 6 ins. in diameter. They operate at a speed of 12½ r.p.m., and a table feed of

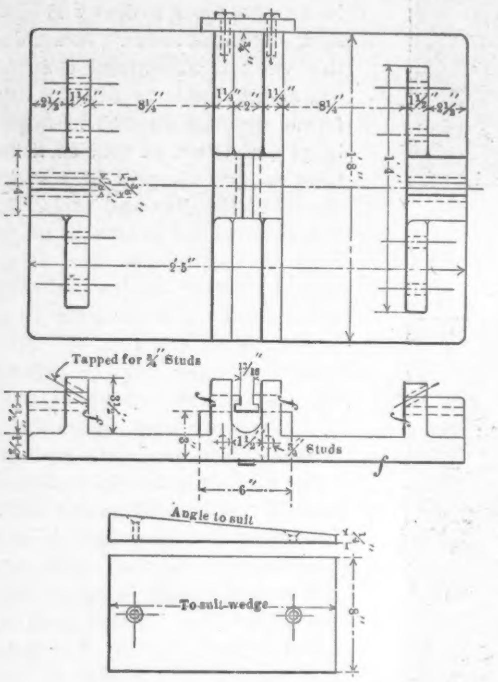


FIG. 1.—JIG USED FOR MILLING SHOES AND WEDGES AND CROSS-HEAD SHOES.

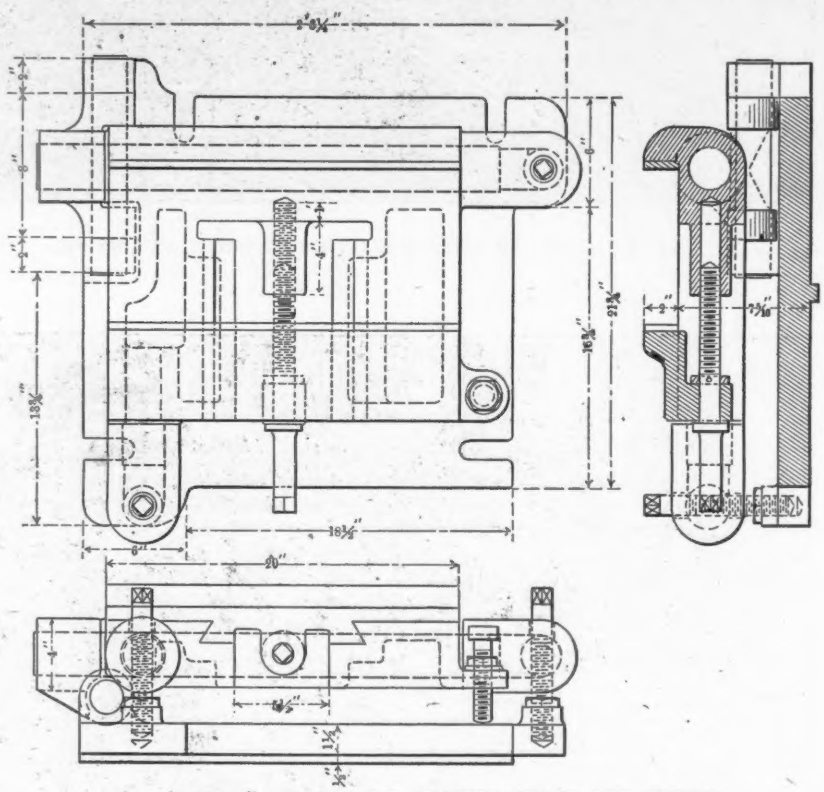


FIG. 5.—CHUCK FOR PLANING SHOES AND WEDGES.

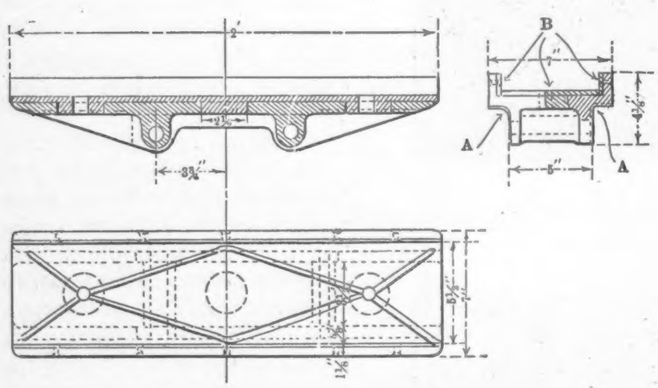


FIG. 6.—CAST STEEL CROSS-HEAD SHOES.

15-16 in. per minute. For the third and last operation (Fig. 4) the jigs are again replaced upon the table, and the three inside surfaces of the shoe are finished by means of the double inserted plate cutters which are 12 ins. in diameter and are adjustable for width. These cutters operate at a speed of 12 r.p.m. with a table feed of 1⅜ ins. per minute. The photographs shown in Figs. 2 and 4 show clearly how the jig illustrated in Fig. 1 is used. The dummy wedge shown in Fig. 1 is fastened in the jig in order to mill the wedge to the proper angle.

The length of time which the cutters, used in these three operations, will run between grindings may be of interest. The inserted tooth cutter used in the first operation will mill at least 250 large shoes or wedges for 4½-in. frames. The large cutters used in the second operation will mill 100 shoes or wedges, by reversing the cutters so as to use both sides; the small cutters are good for more than this. The cutters used in the third operation will mill 100 shoes or wedges. This means that in any of the three operations a man will run his machine for a least one full day and more without having to touch the cutters, and that in any case they will not need to be sent to the grinder until at least two full days work has been done with each of them. These figures are conservative and under these conditions the cutters will at all times give a high class finish. It must be understood that these figures were obtained for castings which had not been put through the tumbler and had only a little brushing with a wire brush, so that they were comparatively rough and sandy, especially in the corners.

The shoes and wedges are now ready to be fitted to the frames of the engine and are marked off for final adjustment, and are then taken to a crank planer where they are planed and the corners rounded. In this connection a special chuck, shown in Fig. 5 is used. This chuck, as may be seen, is adjustable in all directions and was designed by Mr. H. H. Vaughan and made by Foote, Burt & Company.

CROSSHEAD SHOES

The crosshead shoes, which are of cast steel and are shown in detail in Fig. 6, are finished in three operations, which leaves them ready to be babbitted or lined with brass liners and to be fitted to the crosshead body for drilling and for the ends to be cut off to the proper length. The tops and outsides of the flanges of these shoes are finished at one operation by means of gang cutters as shown in Fig. 7. The photograph shows only one row of shoes being milled, but it is the intention to mill two rows of six each at one time as a considerable saving may thus be effected. These shoes may be set up very quickly as each shoe has three cored holes, and it is only necessary to slip the shoes down over short T bolts which are placed in the table slots and to carefully set each shoe the same distance from the edge of the table and parallel with it. The large cutters are of the inserted plate type 12 ins. in diameter and the small ones are solid, 6 ins. in diameter. They are operated at a speed of 16 r.p.m. with a table feed of 1¼ ins. per minute. The photograph shows quite plainly the rubber hose with the T at its end just above the cutter. This hose is connected with a reservoir which furnishes the compound for use when cast steel is

being milled. For the second operation the shoes are turned over and bolted down to the table, and the fit for the cross head body is milled (See A Fig. 6). The cutters used for this operation are of the inserted plate type, 13 ins. in diameter and are operated at a speed of 16 r.p.m. with a table feed of 1¼ ins. per minute. For the third operation the same jig which is used for the shoes and wedges and which is shown in detail in Fig. 1 is used. The three surfaces marked B on Fig. 6 are finished in this operation. Inserted plate cutters 13 ins. in diameter and so arranged that they can be adjusted for width are used and operate at a speed of 16 r.p.m. with a table feed of 1¼ ins. per minute.

We are indebted for information and drawings to Mr. H. H. Vaughan, superintendent of motive power, Mr. H. Osborne, superintendent of shops and Mr. Gustave Giroux, piece work inspector.

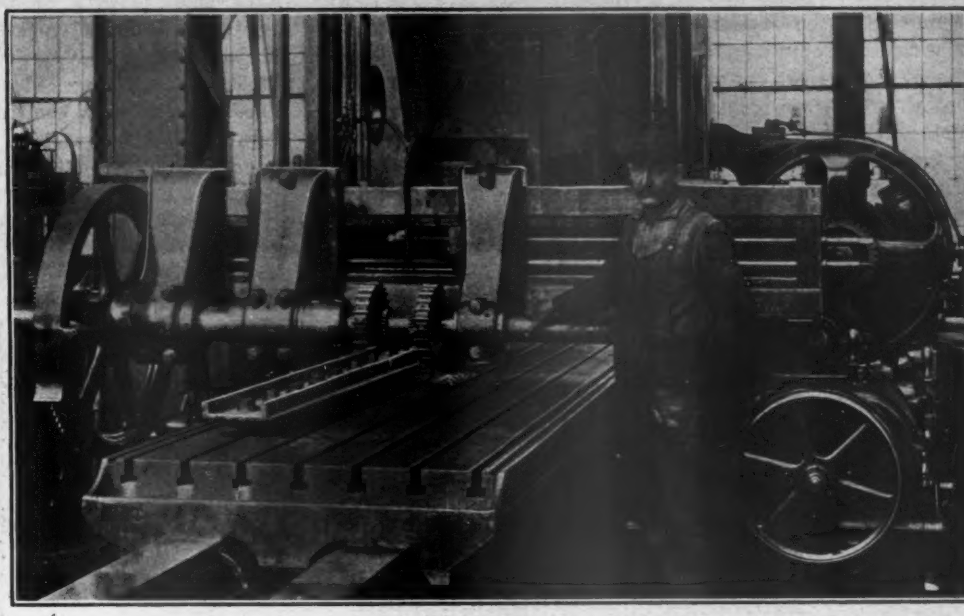


FIG. 7.—FINISHING THE TOPS AND OUTSIDES OF THE FLANGES OF CAST STEEL CROSS-HEAD SHOES.

MECHANICAL DEPARTMENT RECORDS—THE GRAPHIC SYSTEM.

BY L. A. LARSEN.*

To insure satisfactory results in the intricate and manifold interests of railroading, particularly in the mechanical department—to show low costs and high service—an organization must be maintained which shall control the details. These being determined, the results are bound to follow. Among the essential elements of such an organization may be mentioned:

1. Systematic instructions.
   (a) Covering all important matters.
   (b) Complete, concise, and revised as demanded by changing conditions.
2. Assurance that these instructions are being observed, which requires
   (a) Familiarity on part of all concerned with them.
   (b) Regular reports, showing returns.
3. Records, showing plainly the results.

This article does not discuss either the first or second, which deserve separate attention, but treats only of records in the mechanical department. The elements of a good record are (1) accuracy, (2) permanence, (3) simplicity, (4) comparison. There are, in general, three methods of recording results: (1) as contained in the original reports, (2) in books and statements, (3) the graphic system. Each has something to commend itself. The first two certainly bear the stamp of long usage, but this alone cannot be accepted as final in their defense. It is not our purpose to point out the defects of these methods, though we might do so, but to indicate the merits of the third, or graphic system. It has been only in recent years, since the rise of the technician, that the value of the graphic method has been recognized, and its field of usefulness has been but meagerly covered.

The graphic record, or diagram, is of varying sizes and styles, limited only by the varying demands. The most commonly used diagram is made of smooth, heavy white paper, 19 x 24 ins. in size, ruled at right angles in green or orange (as being best for the eye). The two general varieties are termed, respectively, the daily, one-year diagram, and the monthly, ten-year diagram. As these terms indicate, the first is used to record daily occurrences for a period of one year, the second to record monthly occurrences, expenses, etc., for a period of ten years. Reference to the illustrations will more fully explain them. Fig. 1 is a fac-simile of a part of the daily, one-year diagram. Each perpendicular column, 1-24 in. in width, represents one day, and the record shown covers a month of 31 days. The diagram has 366 of these columns, each month being distinctly shown by a heavy line, each five days also being shown by lines heavier than those distinguishing days, but not so heavy as those separating months. In like manner, the horizontal heavy lines separate spaces of five and twenty-five. These lines do not usually indicate periods of time, but are spaced for facility of calculation, each space being denominated as representing a certain number of cents, dollars, delays, etc., as may be considered most convenient. Fig. 3 is a fac-simile of a part of the monthly, ten-year diagram, and represents a record for two years. The lightest perpendicular lines separate periods of one month, those slightly heavier periods of six months, while the heaviest distinguish periods of twelve months. The horizontal lines in this diagram, as in Fig. 1, are flexible in their significance, and for convenience heavier lines distinguish certain spaces. The entries are made by using India inks (black, when but one color is needed), or a 6 H drafting pencil. The latter is more convenient, but the former is more nearly permanent.

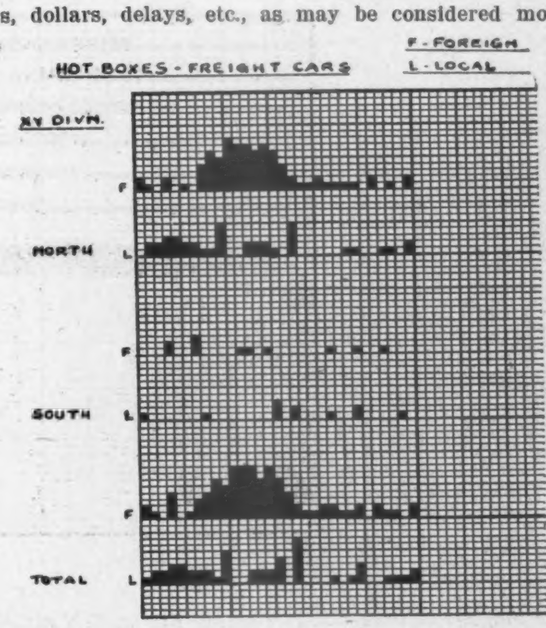


FIG. 1.

* Mechanical Department, N. P. Ry.

Each small square in Fig. 1 represents one car, and it will be noted that on January 1st two foreign and no local cars were reported running hot on northbound trains, and no foreign and one local car running hot on southbound trains, or a total of two foreign and one local. The situation had become much more serious by the 10th of the month, the trouble coming almost entirely from foreign cars. This diagram shows the number of freight cars running hot on X Y division each day, direction of movement, and whether a local or foreign car. Each division is shown in the same manner, and at the bottom of the sheet the system totals are given. A glance will tell which division is having the most trouble, in which direction hot box cars are moving (i. e., what terminal apparently is responsible) and whether foreign or local cars require attention.

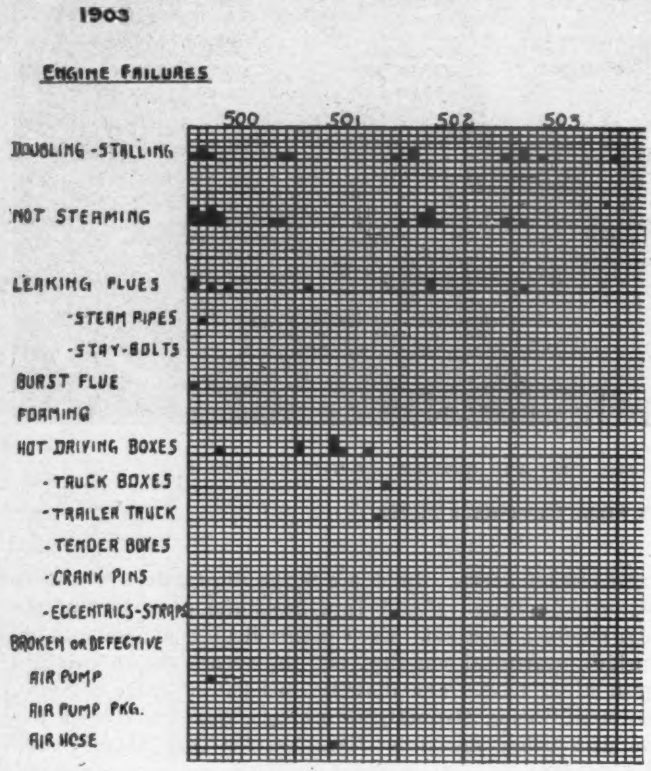


FIG. 2.

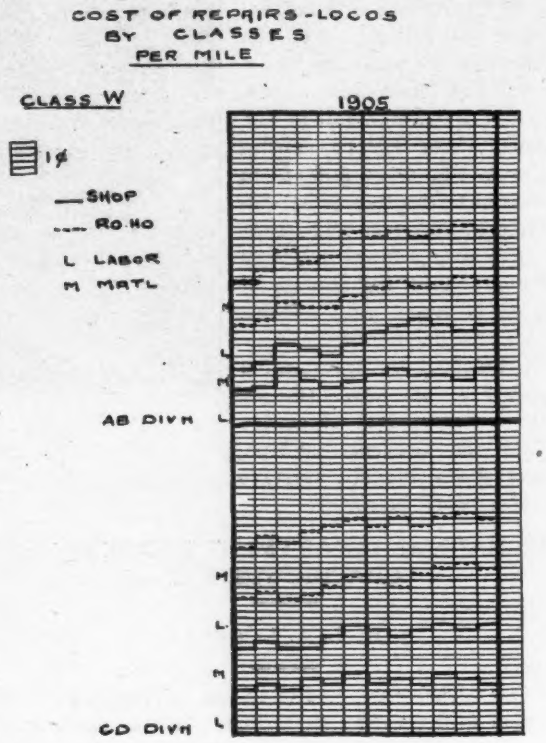


FIG. 4.

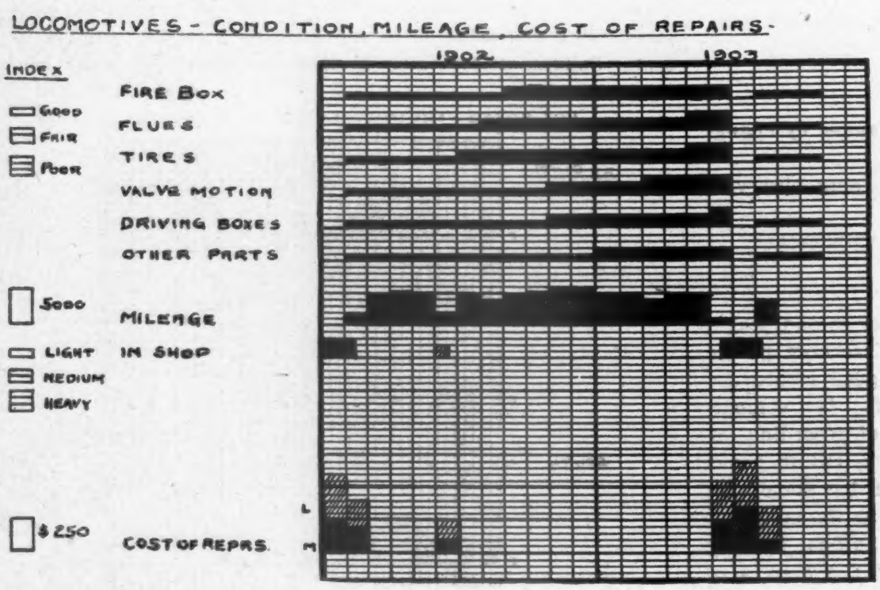


FIG. 3.

The daily, one-year diagram may also be used as a monthly, one-year record, as indicated in Fig. 2. This shows a part of the record of a few engines. All parts of the engine from A to Z are shown in their order under "Broken or Defective." Each small square represents one failure, the twelve perpendicular columns representing months. For example: In January engine 500 failed once doubling or stalling, three times not steaming, twice flues leaking, and once burst flue. The engines follow each other in numerical order, which allows a quick comparison between individual engines of the same class. Each diagram carries a complete yearly record of all failures of 30 engines. Inks of different colors are used to distinguish between different divisions. The comparison offered is threefold, between (1) individual engines or class, (2) parts of same engine, (3) divisions. The value of such comparison, which, it should be remembered, can be made at a glance, is apparent.

The monthly, ten-year diagram is shown in Fig. 3. The perpendicular light lines separate the months, the perpendicular heavy lines separate periods of 12 months. The horizontal heavy lines are base lines from which calculations are made, each block representing a certain number of dollars, cents, miles, etc., as required. Fig. 3 shows the record of one engine. It will be seen that this engine was in the shop undergoing heavy repairs during January and until February 15th. The cost of repairs was: Labor, $550; material, $450; total, $1,000. The condition of the various parts is determined from roundhouse inspection, as good, fair, or poor, according to superintendent of motive power's determinations, and is reported each month. In February the condition of all parts was good, and the engine made 2,000 miles after being turned out of the shop. It was in continuous service until June, when it was in shop for medium repairs on account of being wrecked (this being indicated by cross-hatching on line "in shop"). The cost of repairs this time was $250, including labor and material. By June, 1903, after making about 75,000 miles since general repairs, the condition of the engine had become almost uniformly bad, making it a shop candidate, and it was shopped at a total cost of $1,600; labor, $900; ma-

terial, $700. The comparisons allowed here will occur to the reader. A glance will reveal the condition of an engine as to all vital parts, mileage made each month, when, why, and how long held in shop, cost of repairs, when next due for shopping, etc. One sheet will carry such a record for six engines for ten years.

Figs. 4, 5 and 6 indicate more general records than those above explained, and illustrate respectively records Nos. 11, 12 and 13 in the list given at the end of the article. Fig. 4 is a record of the cost of repairs to class W engines during each month of 1905 on two divisions. Note that shop and roundhouse expense is shown separately and is divided between labor and material. On A. B. division the January cost was $.046 per mile, while on C. D. division the corresponding cost was $.06. Both divisions show an increase from month to month, though for some reason the cost on C. D. division is uniformly higher than on A. B. division. The complete record includes the cost on each division, and total cost for the system. Each class of engine is shown on a separate sheet, so that the number of sheets is determined by the number of classes of locomotives.

Fig. 5 represents a part of the record of the Joyville roundhouse payrolls. Each class of labor is shown separately, and

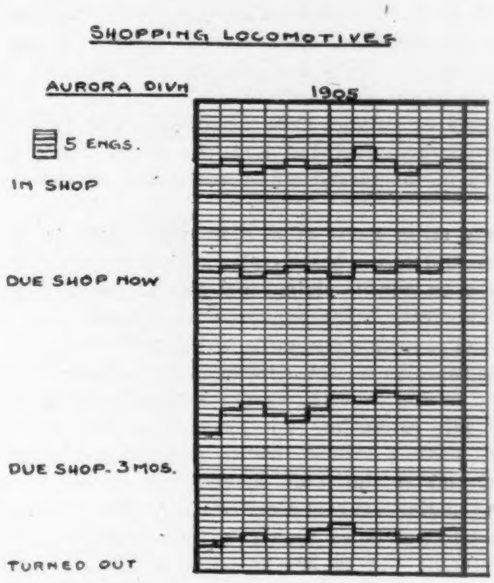


FIG. 6.

rates are shown in figures, e. g., the machinists' roll in January amounted to $80 (1 man), rate $3.45, in April, May and June from $120 to $130 (2 men). The boilermakers' roll increased from $110 in January to $160 in December. At the foot of the sheet the total roll is shown, e. g., in January it was $1,500, and in December $1,700. A recapitulation sheet showing totals of each roundhouse on the system is also used, allowing a quick comparison of all points. It is a simple matter to compare the roundhouse labor expense from month to month without being cumbered with a lot of statements and figures, and it is as simple to make like comparison between corresponding months or periods of various years.

Fig. 6 illustrates a record whose object is to keep the superintendent of motive power informed of the condition of his locomotives, and is a complement to the record of condition of individual locomotives, Fig. 3, giving in a concise form as to all engines on a certain division information concerning locomotives which require shopping within a period of 90 days. The monthly condition reports, referred to in the explanation of Fig. 3, indicate in a sufficiently accurate way for all general purposes the engines which should go to the shop at once or within a period of from 30 to 90 days. The payroll of the shop, being, of course, dependent upon the engines in shop, can then be somewhat accurately foreshadowed, so that on roads where a payroll allowance is made at the beginning of each month, such a record is of considerable value. This record also shows how rapidly the engines of each division are turned out, i. e., the shop output, to know which is often important.

Fig. 7.—Note that while E. F. division has been having the least number of engine failures, varying from 50 in January, 1904, to 20 in August, its record on mileage basis is not so satisfactory as that of X. Y. division, and varies from 6,800 miles per failure in January, 1904, to 9,000 in August. It is easy to see that A. B. division is not making an enviable record.

Fig. 8 illustrates two methods of recording results: (1) by lines connected at right angles, (2) by lines connected from point to point. The first six months' record of 1904 is re-

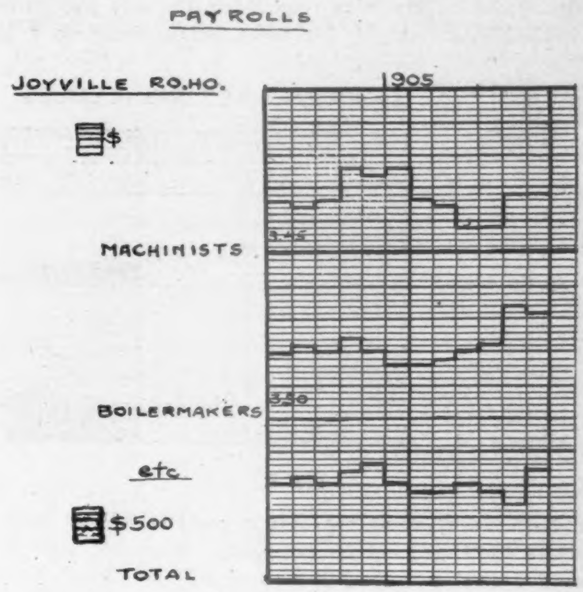


FIG. 5.

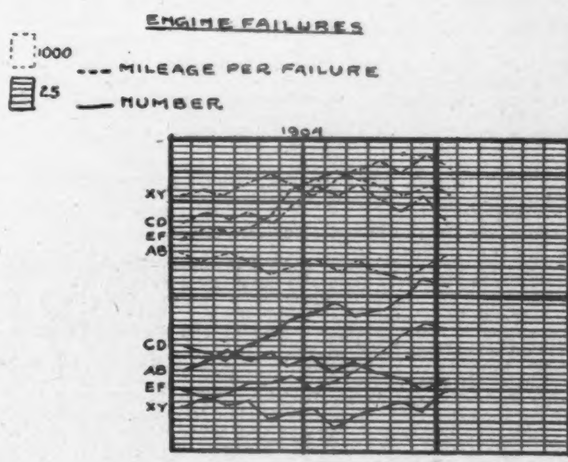


FIG. 7.

peated at the right according to the second method, and by some this is preferred.

In addition to the large office records, the loose leaf diagram book, 4½ x 7 ins., pocket size, may be used to carry the same records. Fig. 8 is a part of such a record, representing the coal consumption, percentage of excess, of two engineers. This record is an important one on lines where account is kept of the consumption of coal by locomotives on an allowance basis. By this I refer to the tonnage system, under which each class of engine is allowed a certain amount of coal per 1,000 ton miles, which varies only among different trains. At the close of each month a compiled statement is issued, showing the amount of coal burned by the engines handled by each engineer, amount allowed, excess consumption, percentage of excess. Inasmuch as the

conditions under which each man works, so far as coal allowance is concerned, are thus practically alike, the saving of fuel is made to be dependent largely upon the personal element, and this diagram record shows plainly what each man is doing. It also indicates the manner in which it may be applied to men as well as things. This book is carried by the master mechanic or road foreman of engines, and each engineman can be shown his record compared from month to month and with that of the men on opposite or similar runs. These loose leaf books, with 150 sheets, sufficient for the records of 300 engineers and 300 firemen for 7 years, cost $1.75 each; extra leaves, 50c. per 100. The 19 x 24-in. sheets cost about 5 cents each in quantities.

It should be explained that the diagrams themselves do not require that the spaces be filled in solidly in black, as shown in Figs. 1 and 3 (this being required in the text only to make the illustrations clear). The lines, being black on a background of green, stand out singly, and, of course, are connected as additional entries are made. It should also be understood that the various illustrations given do not indicate actual results on any certain road, but do represent records actually kept.

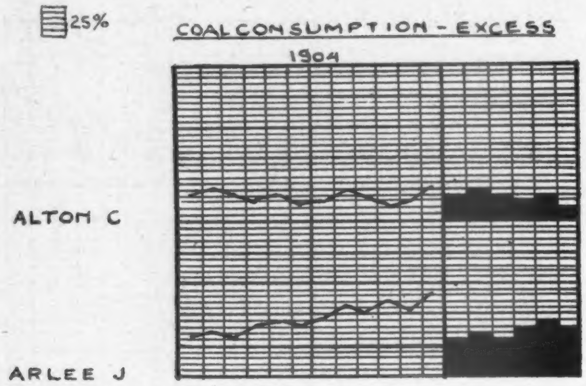


FIG. 8.

As indicating the variety of records which are in actual use, the following may be mentioned:

1. Hot Boxes—Freight Cars—Division, Direction, Foreign or Local, Number Daily, Totals.
   Hot Boxes—Passenger Cars—Direction, Car No., Division, System Totals.
2. Cylinders and Triples Cleaned—Freight Cars—Number Per Month, Stations, Division, System Totals.
3. Slid Flat Wheels—Freight, Passenger, Locomotive, Number Removed, Mileage Per Pair, Each Division, System Totals.
4. Lighting Passenger Cars—Comparative Cost—Pintsch, Acetylene, Electricity.
5. Defective Air Hose Removed—Number, Cause, Manufacturer, Average Life of Each.
6. Repairs to Cars—Freight and Passenger—Total, Labor and Material, Mileage, Cost Per Mile, Etc.
7. Consumption of Oil—(1) Locomotive—Miles Per Pint, Valve, Engine, Etc., Cost Per 1,000 Miles.
   Consumption of Oil—(2) Cars—Freight and Passenger—Miles Per Pint, Cost Per 1,000 Miles.
8. Engine Failures—(1) Individual Engines, Nature of Failure, Date, Division.
   Engine Failures—(2) Total, Divisions, Miles Per Failure.
9. Coal Consumption—(1) Ton and Engine Mileage Per Ton, Various Divisions, Passenger, Freight and Other Classes of Service.
   Coal Consumption—(2) Various Classes of Engines, Comparing Actual With Allowance.
   Coal Consumption—(3) Various Classes of Trains, Comparing Actual With Allowance.
10. Boiler Work—Fireboxes, Flues, Side Sheets, Etc., Applied to Individual Engines, Number, Date.
11. Repairs to Locomotives—(1) By Classes, Cost Per Mile, Labor and Material, Shop and Roundhouse.
    Repairs to Locomotives—(2) Total Cost, Cost Per Mile, Labor and Material, Shop and Roundhouse.
12. Pay Rolls—Actual, Each Month, Each Class of Labor, Stations and Divisions.
13. Shopping Locomotives—Number in Shop, Turned Out, Due in 30 Days, Due in 60 Days, Divisions.
14. Gasoline Used at Water Stations and Coal Docks—Gallons Each Month, Cost of Pumping, Etc.
15. Coal Used at Stationary Plants, R. H. and Shop—Tons Each Month, Each Plant.

The advantages of the graphic record are many; certain may be mentioned:

1. They are simple, concise, handy, easily made and understood.
2. Their first cost, as well as the labor cost of maintaining, is nominal.
3. They are permanent and carry complete data for from one to ten years.
4. They admit of quick and accurate comparisons such as can be made in no other way, as to time, costs, stations, divisions, etc., limited only by the varieties of subjects considered.

In a word, the graphic system is immediate and final in its results, and combines in an eminent degree the elements of a good record: accuracy, permanence, simplicity and comparison.

VAUCLAIN 4-CYLINDER BALANCED COMPOUND PASSENGER LOCOMOTIVE, PACIFIC TYPE.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

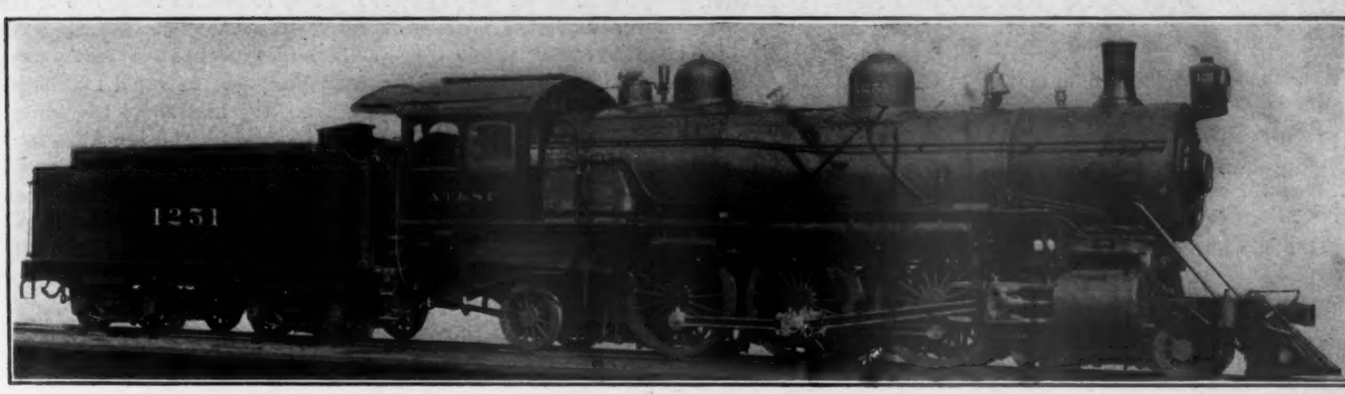
Thirty of these engines have been built by the Baldwin Locomotive Works for the Atchison, Topeka & Santa Fe Railway. This is the second application of the Vauclain 4-cylinder balanced compound arrangement to Pacific type locomotives, the first application having been made to the Oregon Railroad & Navigation Company's locomotives, which were described on page 246 of our July issue. The weight of the Santa Fe engine, as given below, was taken with two gauges of water and a steam pressure of 120 lbs., while the weight of the O. R. & N. engine was taken with three gauges of water and 200 lbs. steam pressure, and, therefore, the weight of the two locomotives under similar conditions would be about the same. The Santa Fe engine, however, weighs considerably more on drivers and is also considerably more powerful, having a tractive power of 32,800 as compared to 28,000 lbs. for the O. R. & N. engine. The cylinders of the two locomotives are of the same size, but the driving wheels for the Santa Fe engine are 4 ins. less in diameter and the steam pressure is 20 lbs. greater.

The Santa Fe engines have a built up crank axle, this being more easily manufactured and the metal being more uniform than in the forged crank axles used on the O. R. & N. engines.

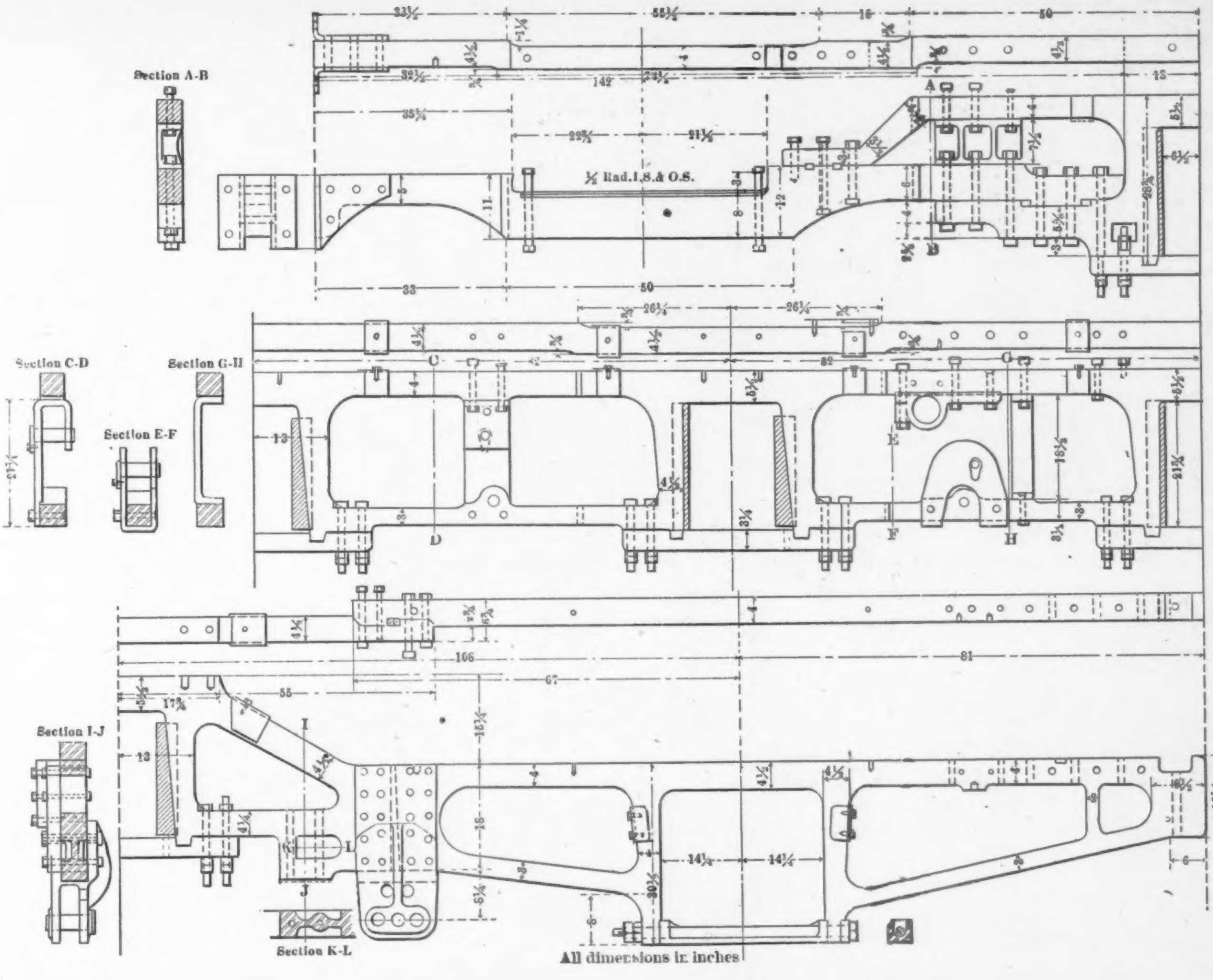
A safety strap made of a ½-in. steel plate is fastened to the boiler and has a brass collar which fits over this axle at the centre to guard against damage if for any reason the axle should break. The engines are equipped with a traction increaser of the same design, as used on the Santa Fe Atlantic type engines. As it was desired to have the driving wheels and axles interchangeable as far as possible with those used on the single expansion type locomotives and as it was necessary to have a greater width between the frames at the cylinders and at the main driving wheels on the balanced compound engine the cast steel frame is offset and made wider at these two points as shown in the accompanying drawing. The bifurcated rod is of the same design as used on the O. R. & N. engine, as shown in detail on page 246, except that it is a little longer. The engine is arranged for burning oil and the tender has a capacity of 8,500 gals. of water and 3,300 gals. of oil. A list of dimensions follows:

PACIFIC TYPE BALANCED COMPOUND LOCOMOTIVE—ATCHISON, TOPEKA & SANTA FE RAILWAY.

GENERAL DATA.	
Gauge	4 ft. 8½ ins.
Service	Passenger.
Fuel	Oil.
Tractive power	32,800 lbs.
Weight in working order (2 gauges water)	226,700 lbs.
Weight on drivers	151,900 lbs.
Weight on leading truck	35,800 lbs.
Weight on trailing truck	39,000 lbs.
Weight of engine and tender in working order	402,783 lbs.
Wheel base, driving	13 ft. 8 ins.
Wheel base, total	34 ft.
Wheel base, engine and tender	66 ft. 1½ ins.
RATIOS.	
Tractive weight ÷ tractive effort	4.63
Tractive effort x diam. drivers ÷ heating surface	.666
Total weight ÷ tractive effort	6.91
CYLINDERS.	
Kind	Compound.
Diameter and stroke	17 and 28 by 28 ins.
Valves	Piston.
WHEELS.	
Driving, diameter over tires	73 ins.
Driving, thickness of tires	3½ ins.
Driving journals, main, diameter and length	11 by 10 ins.
Driving journals, others, diameter and length	9 by 12 ins.
Engine truck wheels, diameter	31¼ ins.
Engine truck, journals	6 by 10 ins.
Trailing truck wheels, diameter	43 ins.
Trailing truck, journals	7½ by 12 ins.
BOILER.	
Style	wagon top.
Working pressure	220 lbs.
Outside diameter of first ring	70 ins.
Firebox, length and width	108 by 71¼ ins.
Firebox, depth, front and back	78¾ and 68¼ ins.



VAUCLAIN 4-CYLINDER BALANCED COMPOUND PACIFIC TYPE LOCOMOTIVE—ATCHISON, TOPEKA & SANTA FE RAILWAY.



CAST STEEL FRAMES FOR SANTA FE PACIFIC TYPE BALANCED COMPOUND LOCOMOTIVE, SHOWING OFFSET AT THE CYLINDERS AND AT THE MAIN DRIVING WHEELS.

Firebox plates, thickness	⅜ and ½ in.
Firebox, water space	4½ ins. front, 5 ins. sides, 4 ins. back.
Tubes, number and outside diameter	290, 2¼-in.
Tubes, gauge and length	11, 20 ft.
Heating surface, tubes	3,402.2 sq. ft.
Heating surface, firebox	192.8 sq. ft.
Heating surface, total	3,595 sq. ft.
TENDER.	
Wheels, diameter	34¼ ins.
Journals, diameter and length	5½ by 10 ins.
Water capacity	8,500 gals.
Oil capacity	3,300 gals.

CUTTING WATER GAUGE GLASSES.—Take a match and cut it; wet the head thoroughly. Having measured the glass, put the wet match-head inside the glass where it is to be cut and turn the glass around several times till a ring is formed on the inside. Then take another match, and having lit it, hold the flame under the mark around the inside, when the operation is complete.—*American Machinist.*

The executive committees of the Master Car Builders' and the Master Mechanics' associations will meet at the Manhattan Hotel, New York, December 11th, and it is expected that the location for the June conventions will be decided upon at that time.

FAST RUN ON THE PENNSYLVANIA.—On November 4th the Pennsylvania westbound 18-hour train left Harrisburg, Pa., two hours late and arrived in Chicago on time. This distance of 717 miles was covered in 741 minutes, the average speeds over different sections being as follows: From Harrisburg to Altoona, 132 miles, 67.8 miles per hour; from Altoona to Pittsburgh, 117 miles, 48.15 miles per hour; from Pittsburgh to Crestline, 55.5 miles per hour, and from Crestline to Chicago, 279 miles, 63.4 miles per hour.

54-INCH RAPID PRODUCTION BORING AND TURNING MILL.

A 54-in. rapid production boring mill, which is the latest development in the Bullard boring and turning mills, is shown in the accompanying illustrations. It has a capacity for work 56 in. in diameter and 42 in. in height; the table is 52 in. in diameter and is driven by a large steel spur pinion meshing with an internal gear of as large diameter as the size of the table will permit. The table has a self-centering tendency, due to the large angular thrust bearing shown in Fig. 3. The side strains are taken by vertical bearings, and the weight of the table and the spindle, as well as the work on the table, tends to preserve the alignment.

An important feature of the machine is that every movement or adjustment, except for the left hand head, may be operated when the brake is set, and it in turn locks the brake lever until the gearing is fully engaged. This inter-locking arrangement safeguards the driving mechanism from careless handling, but does not interfere with the rapid manipulation of the machine, a change from the highest to the lowest speed being made in a very few seconds. The machine may be driven from a countershaft or by a 15 h.p. constant-speed motor mounted on the bracket between the housings, as shown in Fig. 2. This bracket is so designed that if desired the motor may be suspended and gears or silent chain sprockets may be substituted for the belt pulleys.

The feeds are independent for each head, have ten changes ranging from 1-32 to ¾ of an inch for each revolution of the table, and are readily changed or reversed by levers D, E and F. A notable feature in connection with the feeds is the entire elimination of pull gears and crank handles at the ends of rods

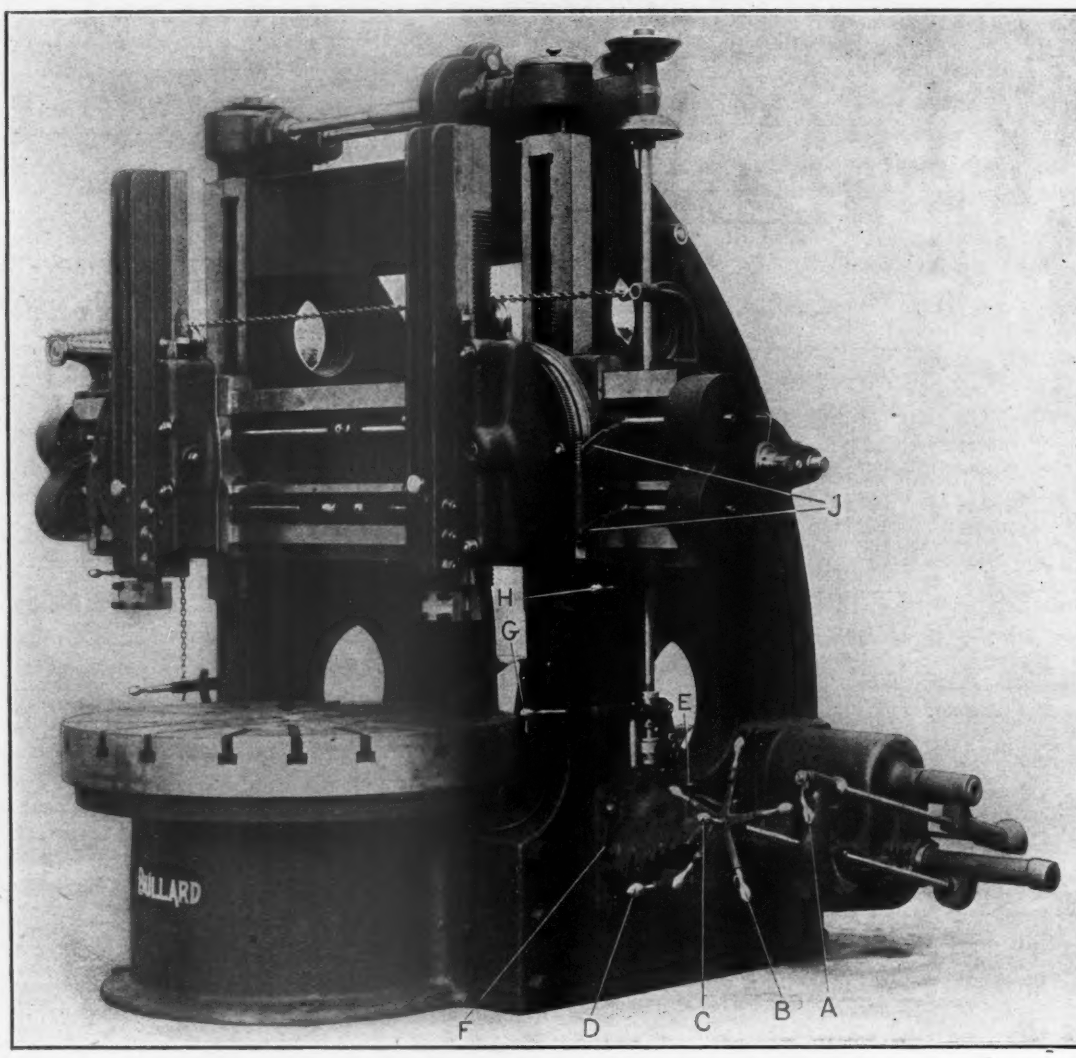


FIG. 1.—BULLARD 54-INCH RAPID PRODUCTION BORING MILL.

made by the operator without moving from his position. Fifteen table speeds are obtained from the speed box, which is shown at the extreme right of Fig. 1, and from the head stock which is mounted on the bed between the housings (Fig. 2). The head stock furnishes three speeds, and any one of these may be obtained by means of lever A, which operates positive clutches. The pilot wheel B controls the changes in the speed box, each spoke indicating one speed, which is engaged only when its corresponding spoke is in a vertical position. The brake lever C, which is on the same shaft as the pilot wheel B, is operated by lifting. This brake allows the table to be instantly stopped at any point, and can be applied only when the frictions are disengaged, and the pilot wheel spoke is in a neutral position; it is impossible to turn the pilot wheel while the brake is on. The lever, which controls the changes in the head stock gearing, can only be and screws; pull gears being replaced by gears constantly in mesh, and change from vertical to cross feed, or vice versa, being made by adjustable friction clutches operated by the lever H. This device multiplies many times the value of the rapid traverse and serves the purpose of a safety slip point in an otherwise positive train of feed gears, obviating all chance of breakage and delay through careless handling.

Rapid power traverse of the head and tool bar is obtained from the vertical feed rod, the cone frictions at its upper end being engaged by the horizontal lever G, shown at its lower end. In its central position the feeds are engaged, but by raising or lowering the lever the clutch is released and the cone frictions brought into contact with a high speed top shaft and the rod revolved at a high rate of speed. The connection between the feed box and feed rod is a claw clutch, so arranged as to engage in but one position; the rapid

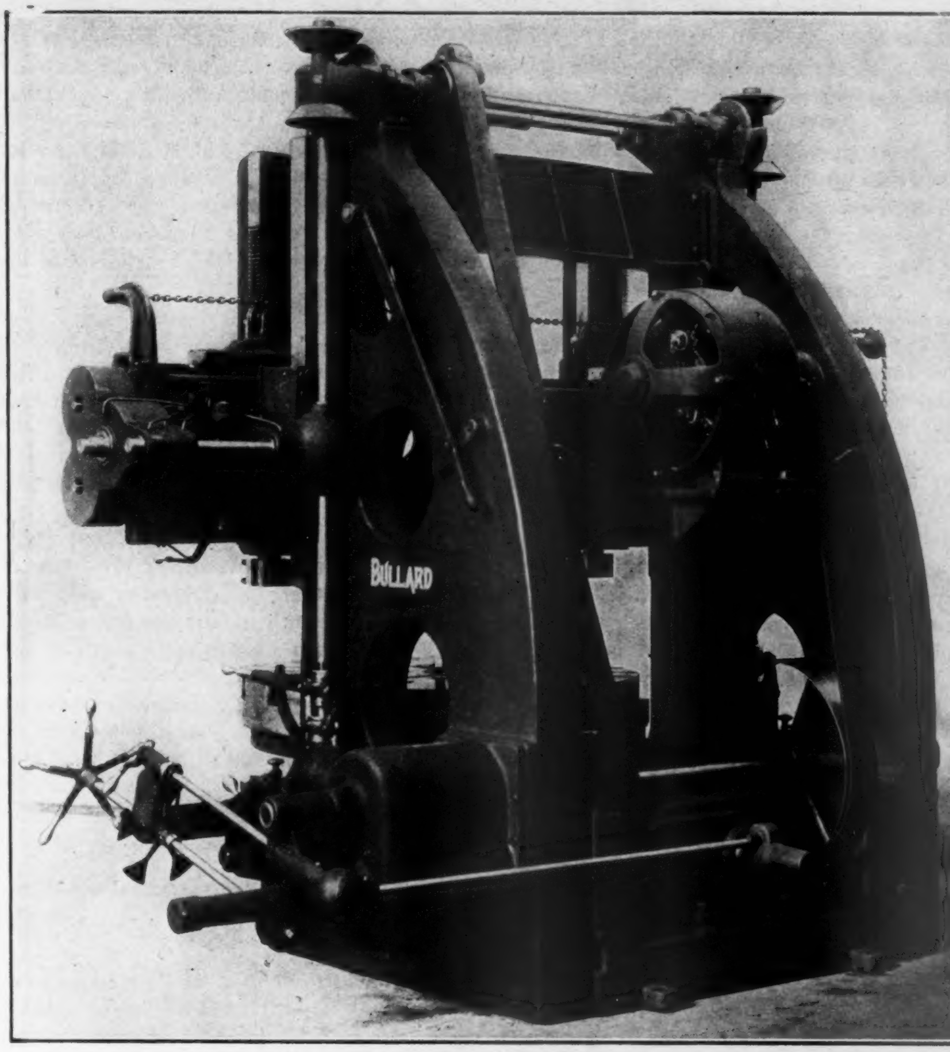


FIG. 2.—REAR VIEW OF BULLARD BORING MILL, SHOWING APPLICATION OF MOTOR DRIVE.

Lubrication of all parts subject to wear has received special attention. Both the headstock and speed box are entirely enclosed and the splash system of oiling is used, the gears running in a constant bath of oil. All high speed shafts have ring or chain oiling boxes and gauges are so placed as to indicate the amount of oil in each. The angular thrust bearing of the main spindle is entirely immersed, oil pockets in the bed insuring ample lubrication of its entire surface, while a felt ring feeds oil to the vertical journals. In Fig. 3 will be seen the main features of this bearing, also the indicator for proper oil level at the left side of the bed. This machine weighs about 17,500 lbs., and is made by the Bullard Machine Tool Company, Bridgeport, Conn.

RAILROAD Y. M. C. A.—From May 1st, 1903, to May 1st, 1905, the number of associations increased from 194 to 207; the number of buildings from 114 to 130; the membership from 62,348 to 74,324; the average daily attendance from 27,831 to 33,951; the rest rooms used from 841,179 to 1,144,457; students in educational classes from 1,851 to 2,664, and the students in Bible classes from 2,883 to 4,183. The rapid growth during the past two years is very encouraging.

traverse may be used in thread cutting with no danger of a split thread resulting. The feeds are reversed in the feed box, so the position of the traverse lever bears a constant relation to the direction of movement in the head and bar, confusion in the mind of the operator being entirely obviated.

Fine adjustment of the cutting tool is made by the double acting ratchet levers J, shown attached to saddle. These ratchets automatically release their grip when actuating pressure is relieved. This device renders it possible for the operator to set the tool to the proper depth of cut or the diameter required at close range and saves the time consumed in going to the end of the rail to make adjustments as in the case of the ordinary machine having crank handles.

The construction of the rail is a feature which adds much to the rigidity and accuracy of the mill, as the entire weight of the head is supported by the bearing at the bottom of the rail, the upper bearing serving only to resist the tendency of the head to tilt forward under the pressure of the cut. The feed screw is in the centre of the long, narrow, guide bearing, consequently there is no tendency to cant and bind on the rail as in the usual construction. This principle of a guide bearing having a greater proportion of length to width is also used in maintaining the alignment of the centre stop on the rail, the rail being held central by a gibbed block having its bearing in the recess in the face of the right-hand housing.

Another notable feature is the method of driving the top shaft which operates the rail lifting screws. The change in direction of movement is secured by tumbler gears, the driving pinion of which is cut in the end of a quill which is a running fit on the top shaft, the driving key being located in the middle of shaft in order to equalize the torsion between the ends.

FIG. 3.—ANGULAR THRUST AND VERTICAL BEARINGS OF BULLARD BORING MILL.

TECHNICAL PUBLICITY ASSOCIATION.—At a meeting and banquet of this association, held at the Aldine Club, New York, November 3d, the following officers were elected. President, C. B. Morse, Ingersoll-Rand Company; 1st Vice-Pres., H. M. Cleaver, Niles-Bement-Pond Company; 2d Vice-Pres., Frank H. Gale, General Electric Company; Secretary, Rodman Gilder, Crocker-Wheeler Company; Treasurer, H. M. Davis, Sprague Electric Company; members of Executive Committee: Graham Smith, Westinghouse Companies and Chas. M. Manfred, Johns Manville Company. Mr. H. M. Davis addressed the association on "The Advertising Appropriation."

OIL FURNACES.

The following is taken from a paper presented before the National Railroad Master Blacksmiths' Association by Mr. J. G. Jordan:

What I believe to be the most important point in constructing an oil furnace so that it will work properly is to have sufficient air or fan blast to cause the proper combustion in the furnace. In order to do this you must have not less than eight ounces of fan blast, or from 60 to 75 lbs. of air pressure, to cut your oil or spray it properly into the furnace. The construction of the burner also forms a very important item in the successful operation of an oil furnace. We have many kinds of burners in the different furnaces in our shops, such as steam, compressed air and fan blast burners. We use only air and fan blast in the blacksmith shop, as we believe them to be the best. I tried steam burners, but they do not work well on account of the water in the steam, which prevents getting a good welding heat on the iron. We have one large scrap, or axle, furnace, in which we heat 10-in. driving axles. It is operated with a 10-oz-fan blast, three burners at one end, and stack at other end, and has two doors. The burners are made of 3-in. gas pipe, with ⅜-in. oil pipe in center. In constructing pipe burners you should have the oil pipe back of blast pipe, and 1½ ins. from the end of same, and protected by about 2 ins. of extra fire brick inside the furnace. Without this arrangement you will experience great difficulty in keeping the oil pipe clear of the severe heat with which it comes in contact inside the furnace. There should be a combustion chamber on every scrap furnace, or a firebox about 3 ft. wide, with a bridge extending well over the burners, so that the oil will have no possible chance to come in contact with the piles of scrap or slabs in the furnace. If the oil does come in contact with the slabs, you will have black seams or streaks in the forging, and when it is planed or turned up the forging will be condemned. This, of course, makes no difference in any but a welding furnace.

A bolt furnace should have a water front and a continuous stream of cold water running into the bottom of the water front, and the hot water running out through a waste pipe at the top. In this way the heat in front of the furnace will be diminished, which makes it much more comfortable to the man heating the iron. A bolt furnace should have two burners, one at each end, so that in case one burner gets out of working order the other can be used. In all cases you must use blast in both burners, and oil in only one; otherwise, the burner which is not working will be damaged or ruined by the excessive heat. We use from 40 to 50 gals. of fuel oil in ten hours in one of these bolt furnaces.

A spring furnace should have a combustion chamber, or firebox, and a stack to carry off the gases arising from the oil, so the springmaker can stand close to the door at all times with comparative comfort, in order to gauge the oil to keep the furnace at the same degree of heat and prevent overheating the steel. Our spring furnace has two burners at one end and stack at the other. It has a firebrick floor, and is large enough to heat the longest spring leaves.

The construction of a flue furnace differs materially from any other, on account of the short heat taken in welding the scarf end on the flue. A flue furnace should have a combustion chamber, and from it should lead a narrow passageway (say about 4 ins. square) to where the flame comes in contact with the flue. After it passes the flue there should be a stack to draw off the blaze. If you have no stack you will get too long a heat on the flue, and it will be almost impossible for the flue-welder to stand by his machine, on account of the intense heat and the gases arising from the oil. With the old coke furnace 200 flues was a good day's work, while with one of these oil furnaces 400 flues can be welded in ten hours with ease.

In regard to the kind of furnace best adapted for a bulldozer, for heating arch bars, and all other work that needs forming or bending, I would suggest that it be wide enough to accommodate the longest piece of iron to be bent. Also that it have one door opposite the one out of which you are working, so when you have a piece of iron of extraordinary length you can put it through the opposite door. It should have two burners at one end and a stack at the other, to draw off the surplus heat and gases, so that you can put your machine close to the furnace door and save the unnecessary expense of handling the material a distance. No combustion chamber or firebox is necessary with this furnace, as no welding is done with it, and the burners can be run right into the furnace.

There is another kind of furnace that I wish to call your attention to, and that is a special furnace built for use in straightening steel underframing for freight cars. When cars are wrecked, as you know, it does everything to them except tie them in a knot. In some cases they are 20 ins. wide and 40 ft. long, so I built a special furnace for them. This furnace is 9 ft. long, 30 ins. wide, and has two air burners on one side and two doors, one at each end, so that we can run the sheets clear through and heat them at any place where they are bent. This is a very good furnace for this class of work, as you can erect them at any place needed, and with very little expense can run air into it, and set out a car of oil next to it. The oil cars are of sufficient height to run the oil into the burners by gravity. By this process you can take an 8-ft. heat on a sheet ½ in. thick in about five minutes.

In conclusion, I wish to say that I am a firm believer in oil furnaces, as the work that we turn out with them is double and over, and sometimes treble, the work done with coal or coke. Even if oil was considerably higher and coal proportionately low, it would pay to use oil on account of the greater output of work.

HOW STEEL AXLES FAIL.

Coming now to actual conditions of service, in a car-axle, for example, the maximum fiber-stress allowable by calculation is from 18,000 to 20,000 lbs. per sq. in. in certain parts of the axle, and 7,000 to 10,000 or 12,000 lbs. in other parts. The experience of the Pennsylvania Railroad indicates that, with this maximum calculated fiber-stress, if the metal used in car-axles is steel of not above 65,000 or 70,000 lbs. tensile strength, the axle will sooner or later fail in service. The method of failure is peculiar and worth a word of remark. For example, instead of the journal breaking off from the axle suddenly, due to shock (as we are quite accustomed to see things break), apparently the metal that has the maximum fiber-stress begins to break without any elongation or stretch. This, of course, will be at the surface of the journal, usually at the fillet of the shoulder. A single fiber, if we may use the expression, having broken, the next fiber underneath it receives the maximum fiber-stress slightly increased, and it ultimately fails, and so on, until after a while there will be quite a large portion of the section of the axle broken off in this manner. Then some sudden shock breaks the rest of it and the journal drops off. This breaking of the parts subjected to the maximum fiber-stress, a little at a time, is known as "detail fracture," or sometimes as "progressive fracture." It is a real difficulty and occurs in many places besides car-axles.

With our present knowledge of the subject, the remedy for the failure of a part due to detail fracture is twofold: (1) Either increase the size of the part, which with the same loads will diminish the fiber-stress, as is clearly evident, or, (2) change the nature of the steel, so that the ratio between the calculated maximum fiber-stress and the ultimate tensile strength will be greater; that is to say, if we may trust the experience of the Pennsylvania Railroad, if the maximum fiber-stress between wheels is 20,000 lb. and a steel of 65,000 or 70,000 lb. tensile strength is used sooner or later there will be failures in the car-axles between the wheels. On the other hand, with exactly the same sizes and loads, and consequently the same maximum fiber-stress, if the steel used is from 80,000 to 85,000 lb. tensile strength, there will be no failures during the life of the axle.

The point to which I am leading and to which all that I have said is preliminary, is this:—Iron and steel do not behave alike, when subjected to bending-stresses. We think it is perfectly safe to say that a well-made iron car-axle, the metal of which will show in tensile strength from 48,000 to 52,000 lb. per sq. in., will stand successfully the same fiber-stress as steel of 80,000 to 85,000 lb. tensile strength. Just why this is so, I am unable to explain, but there is a very large amount of accumulated experience which seems to indicate that a metal like iron, which is believed to be a bundle of fibers, each one surrounded by slag, and which has within itself the power of the distribution of the strain, is a more reliable metal when subjected to bending stresses than a perfectly homogeneous metal like steel. This is hardly the place or the time to go into a discussion of this phase of the case, and so I close by saying, that the present outlook seems to be that if wrought iron can be made in sufficiently large masses, so that flaws and defective welds will be eliminated, it might again become a successful rival of steel, especially if it can be made at a cost that will permit of commercial competition.—*Dr. Charles B. Dudley, American Institute of Mining Engineers.*

NEW DRAFT APPARATUS FOR HANDLING HOT GASES.

In handling hot gases with a fan, as in a plant producing induced draft for boilers, it is practically impossible to give the fan shaft a suitable bearing at the inlet side, as it would necessarily be situated in the inlet area and would be surrounded by hot flue gases. Much better results have been obtained by the use of an overhung wheel having in addition to the two engine bearings a bearing on the engine side of the fan, but none on the inlet side. This form of construction has, however, given considerable trouble because of the difficulty of lining the third bearing up with the two engine bearings.

FIG. 1.—NEW DRAFT APPARATUS FOR HANDLING HOT GASES.

Fig. 1 shows a new method of construction, which overcomes this difficulty. All three journal boxes are cast in the engine frame and can all be bored with the same boring bar, and will, therefore, be in line. The fan bearing is water cooled and ring oiled. With this arrangement self-aligning bearings are not necessary and the construction is simplified, as the bearing is supported by the engine bed, and not by the housing of the fan, and additional bracing for the fan housing is not required.

The construction of the wheel has also been improved upon. One heavy spider built of I beams cast into the hub is used in place of the ordinary arrangement with three spiders. The blades are braced as shown in Fig. 2. This construction is fully as strong and rigid as the three spider arrangement, and by the use of a single spider the necessity for more than one hub on the shaft is obviated and the load of the wheel is concentrated upon a comparatively short length of shaft. With the deep cone in the casing, as shown in Fig. 1, and the fan bearing setting as far in it, as it does, the distance from the fan housing and the centre of gravity of the fan is very short and the weight of the shaft acting on the fan bearing as a fulcrum does not cause an upward thrust in the engine and on the engine journal caps.

FIG. 2.—NEW TYPE OF FAN WHEEL.

The engine is of the enclosed type and is oiled by a recently designed pump which distributes copious streams of oil over the reciprocating and revolving parts, even lubricating the eccentrics outside of the frame. Tests have shown that it will run several months without oiling or adjustment. This outfit is manufactured by the American Blower Company of Detroit, Michigan.

The record was broken at the Baldwin Locomotive Works during Occtober, when 225 locomotives were turned out. For the first six months of this year 1,000 locomotives were completed.

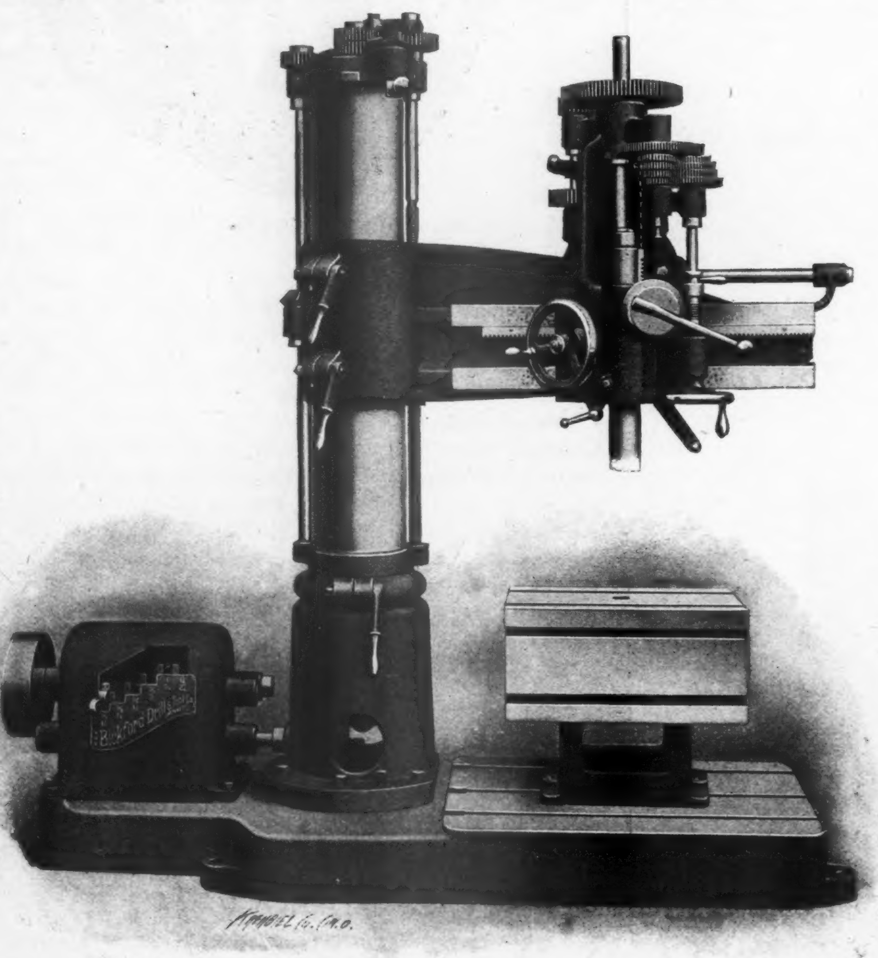
MODEL LOCOMOTIVE FOR PURDUE.—Mr. Henry F. Shaw of Boston, well known in railway circles for his devotion to the problem of balancing the reciprocating parts of locomotives, has presented to Purdue University a model locomotive embodying his latest design. The model is constructed on the scale of 1 inch to the foot, and is an excellent piece of work.

RAILROAD STATISTICS.—According to the most recent German statistics, the length of the railroads of the world was 537,105 miles on December 31, 1904, of which 270,386 miles were in America, 187,776 miles in Europe, 46,592 miles in Asia, 15,649 miles in Africa, and 16,702 miles in Australasia. Of the mileage of European railroads, Germany stands first (34,016), followed in their order by Russia (33,286), France (28,266), Austria-Hungary (24,261), the United Kingdom (22,592), Italy (10,025), Spain (8,656), Sweden and Norway (7,730). The average cost of construction of the European railroads per mile is estimated at $107,577, while for the remainder of the world the estimate is only $59,680. The total value of the railroads of the world, according to these statistics, is $43,000,000,000, of which the European roads figure for 22,-000,000,000. The estimate for rolling stock is as follows, in numbers: Locomotives, 150,000; passenger coaches, 225,000; and freight cars, 3,000,000.—*Consul-General Guenther of Frankfort.*

2½ AND 3 FOOT RADIAL DRILL.

The radial drill illustrated herewith is of new design throughout. It is adapted for a medium class of work, and has a capacity for drilling holes from the solid up to 2 in. in steel and 2½ in. in cast iron. One of the most important improvements is the speed box, which, without back gears or a clutch of any kind, gives instantly with a single lever any one of six changes of speed.

Referring to the diagram showing a section through the speed box: C is the driving shaft, to which is keyed the fixed gear D and the sliding gear B; the tumbler plate A on this shaft carries the intermediate gear E, which meshes with B and with any one of the fixed gears, G, H, I, J and K, on the shaft L. The intermediate gear F transmits continuous motion from the fixed gear D to the loose gear M, which carries a pawl and runs on the hub of a ratchet keyed to the shaft L and a device for automatically engaging the pawl or keeping



2½ AND 3-FOOT BICKFORD RADIAL DRILL.

it away from the ratchet. The slowest speed is obtained by sliding the tumbler plate A to the last notch on the right when the intermediate gear E occupies the space between gears K and M, and power is transmitted to the shaft L through gears F and M. Moving the tumbler plate A to the next notch brings the intermediate gear E into mesh with gear K and causes the ratchet on the shaft L to disengage from the pawl in gear M. The shaft L is always in operation; the moment its speed drops below that of the gear M the pawl in the gear acts automatically and keeps it turning until the gear B is again made the driver. As the minimum peripheral speed of the smallest driving gear G is but 182 ft. less than the peripheral speed of the driving gear B, the shock which usually accompanies the engaging of gears broadside, is reduced to a minimum and is absorbed by the belt. The shaft C runs at 350 revolutions per minute, and the highest peripheral speed of any gear in the box does not exceed 301 ft. per minute.

TABLE 1.—LIST OF SPEEDS.

No. Revolutions per Minute Made by Spindle.	Diameter Drills for which Speeds are Suitable.	No. of Feet per Minute at which Drilling is Done.	No. of Feet per Minute at which Drilling Should be Done.
265.09	½	34.60	35.0
209.86	⅝	34.34	34.3
173.68	¾	34.10	33.6
143.91	⅞	33.07	32.9
122.84	1	32.16	32.2
104.29	1⅛	30.72	31.5
95.41	1¼	31.22	30.8
75.53	1½	29.66	29.4
62.51	1¾	28.74	38.0
51.79	2	27.12	26.6
44.21	2¼	26.04	25.2
37.56	2½	24.56	23.8

The speed box in connection with the back gears on the head furnishes the machine twelve changes of speed, the range and gradations of which are shown in Table 1.

A comparison of the figures in the first three columns indicates that the manufacturers have exercised great care in the selection of the gears, as in no instances does the cutting speed vary from the theoretical one by more than .84 of a foot per minute.

An interesting fact, which is very nicely illustrated in Table 2, which was furnished us by the manufacturer, is that speeds which are in true geometrical progression are not by any means the best ones to be used on a machine tool of this kind

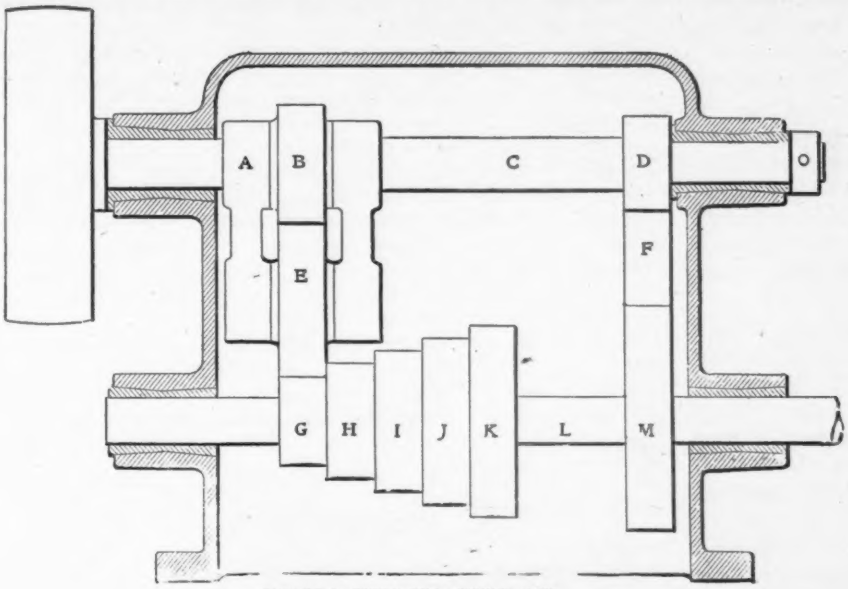
An inspection shows that instead of giving a series of cutting speeds, as shown in Table No. 1, in which no speed is more than .84 of a foot too high, nor .78 of a foot too low; the cutting speeds in the geometrical series vary from 2.88 too high to .92 of a foot too low; in one case the maximum error is but 2.47 per cent. and the average error but .834 per cent., while in the other the maximum error is 8.57 per cent. and the average error 3.903 per cent., or more than four times greater.

TABLE 2.—SPEEDS IN TRUE GEOMETRICAL PROGRESSION.

Geometrical Series.	Diameter of Drills.	Periphery Speeds.
265.09	½	34.60
221.90	⅝	36.31
185.81	¾	36.48
155.54	⅞	35.63
130.26	1	34.10
109.04	1⅛	32.12
91.31	1¼	29.88
76.43	1¼	30.01
64.00	1¾	29.32
53.60	2	28.06
44.85	2¼	26.41
37.56	2½	24.56

The back gears consist of three gears and a clutch, located

on the head, and they may be engaged or disengaged from the front of the machine while it is running. The feeding mechanism furnishes four rates of feed, advancing by even increments from .008 to .020 in. per revolution of the spindle, each of which is instantly available. The sleeve is mounted on a stationary stump which extends up to and has a bearing at the top of the machine. By means of steel tumbler gears the arm is lowered at double the speed at which it is elevated. The tapping mechanism is incorporated in the head and allows the taps to be backed out at any speed with which the machine



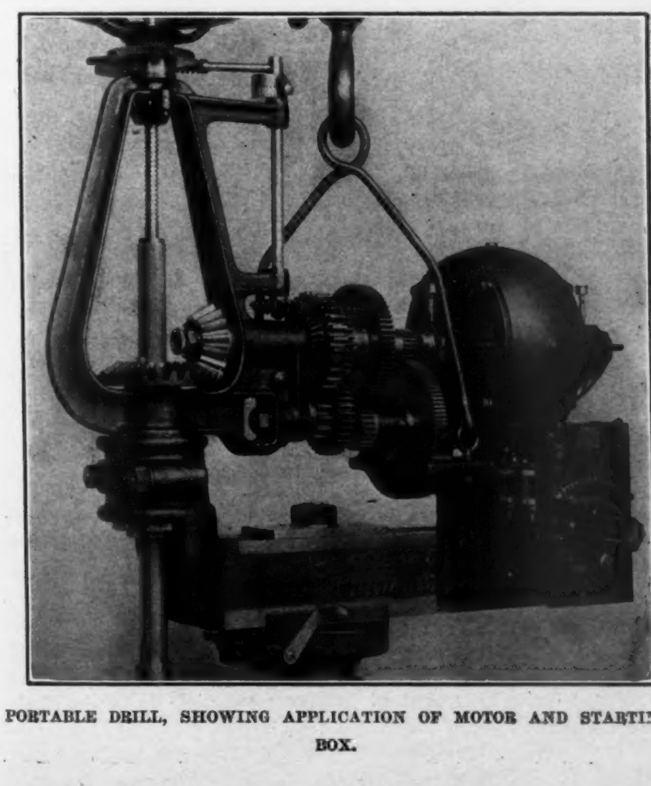
SECTION THROUGH SPEED BOX.

is provided. It is equipped with a friction clutch, which, owing to the back gears being located between it and the spindle gear, is obliged to transmit but one-sixth the pull required at the spindle. These machines are made in 2½ and 3 ft. sizes, which weigh 3,620 and 3,750 lbs. respectively, and are manufactured by the Bickford Drill & Tool Company, Cincinnati, Ohio.

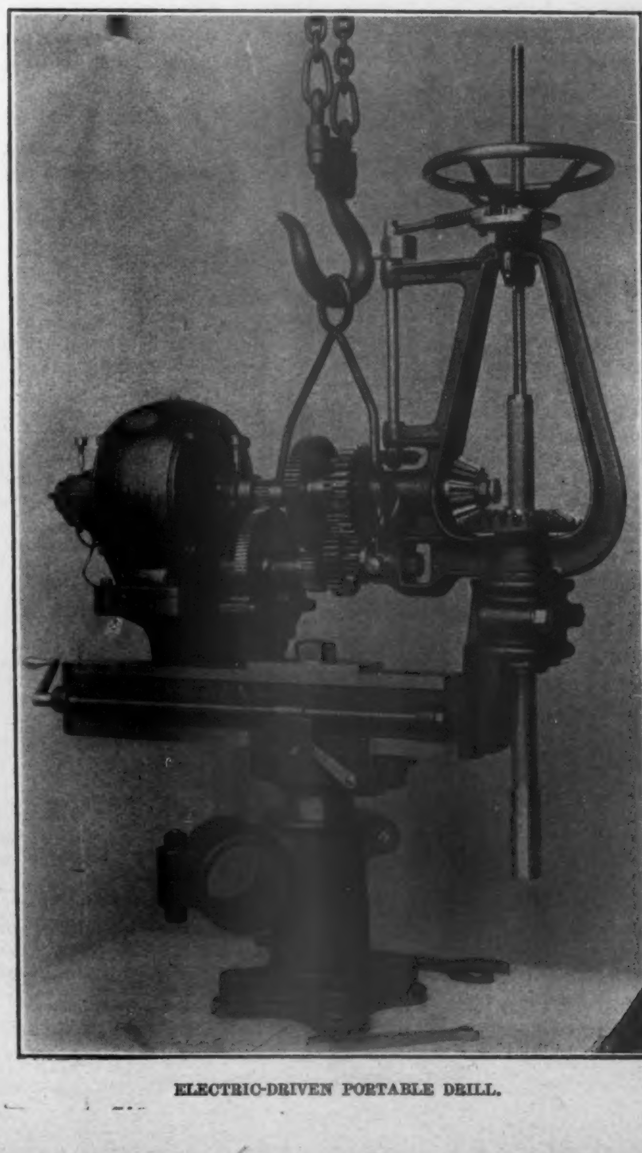
ELECTRIC DRIVEN PORTABLE DRILLS.

For several years Dallett portable drills have been adapted for motor drive, using a special motor and a planetary gear reduction. At the present time, however, they are redesigning their entire line of portable drills, adapting them for motor drive, using standard motors, and machines Nos. 4 and 5 are now upon the market. These machines are provided with a sling for convenient handling by crane, and are extensively used where a portable drill is required for doing heavy or awkward drilling or boring. They are also adapted for a large range of regular work when not employed for portable purposes, and as these two sizes are powerfully back geared, they will do practically the same work as may be accomplished by the use of a large standard drill press or radial drill. Their capacity for different purposes is limited only by the ingenuity of the operator in adapting them to various situations and uses.

The illustrations show a No. 5 machine equipped with a 3-h.p. variable speed Northern Electric 220-volt motor. The general design of No. 4 is practically the same. These drilling machines have a base containing two bearings, one vertical and one horizontal, allowing the machines to be used for either vertical or horizontal drilling. The base is provided with four slotted lugs, by which it can be bolted on or near the piece to be drilled or bored. In this base is fitted a post adjustable to allow for the use of different lengths of drills and sockets in the spindle. On this post, on top of which is cut a worm wheel, is fitted a cup washer containing on one side a bearing with a worm which meshes in the worm wheel on the post by which it can be entirely revolved around the axis of the base.



PORTABLE DRILL, SHOWING APPLICATION OF MOTOR AND STARTING BOX.



ELECTRIC-DRIVEN PORTABLE DRILL.

The frame of the machine rests in a groove planed across the top washer, and is clamped firmly in place by a square washer on top and a stud tapped into the post. This frame has a movement lengthwise at right angles to the axis of the base, is actuated by a side screw, and has at its front end a clamp bearing to receive the drill head. The drill head consists of a frame with a spindle, feed screw and feeding device. The feeding mechanism consists of a pair of bevel gears, feed-shaft, rocker, pawl, ratchet, pawl-plate, wheel, feed nut and feed screw, the latter pressing directly upon the top end of the spindle, the thrust being taken by a fibre-washer, and is coupled to the spindle by a yoke-nut. The connecting rod between the crank and rocker pawl is fitted with a spring, which may be set for any pressure of feed, so that when this pressure is exceeded the spring will be compressed and the feed will cease to operate until the excessive pressure is relieved. A change of feed from one tooth to seventeen is effected by shifting a thumb-latch, no wrench being required. The back gear is thrown in mesh by an eccentric shaft, which is locked in place with a thumb screw. When the back gear is in use the key is unclutched from the cone shaft by throwing out a clutch key.

No. 5 portable drill has a radial adjustment of 26 ins., drilling at one setting anywhere over a surface of 72 ins. outside diameter and 22½ ins. inside diameter. The spindle is provided with a No. 5 Morse taper, has a diameter of 2 1-16 ins., a traverse of 20 ins., and the range of speeds is from 19 to 90 r.p.m., with a feed of from .005 ins. to .075 ins. per revolution of the spindle. The net weight of the machine, complete, is 1,300 lbs.

The No. 4 drill has a radial adjustment of 28 ins., drilling at one setting anywhere over a surface of 56 ins. outside diameter and 16 ins. inside diameter. It has a spindle traverse of 12 ins., with a diameter of spindle of 1 11-16 ins., and is provided with a No. 4 Morse taper. This machine has a range of speed from 29 to 153 r.p.m., with the same feeds per revolution of spindle as the No. 5. The vertical adjustment of the post in the base is 6 ins., as against 8 ins. in the No. 5 machine. The net weight of the No. 4 machine is 765 lbs. These machines are made by the Thomas H. Dallett Company, Philadelphia, Pa., and they expect in a short time to be prepared to furnish any of the other sizes of their drilling machines equipped for standard motors.

BOOKS.

The *Mechanical World* Pocket Dairy and Year Book for 1906. Published by Emmott & Co., Ltd., 118 Chancery Lane, W. C., London. Price, sixpence, net.

This little volume contains over 250 pages of useful engineering notes, rules, tables and data, and, in addition, has about 50 pages for a diary and memoranda for 1906.

Faulty Diction or Errors in the Use of the English Language and How to Correct Them. By Thos. H. Russell, LL.B. 150 pages. Published by Geo. W. Ogilvie & Co., Chicago, 1905. Bound in Russia leather, 50 cents; bound in cloth, 25 cents.

This little book is invaluable to those interested in the correct use of the English language. It considers briefly and to the point common errors of grammar, of construction or faulty rhetoric and unauthorized words which are commonly used. Pronunciation is indicated by careful re-spelling without the use of diacritical marks, which are confusing to those not familiar with their meaning. The book is of "vest-pocket" size.

Proceedings of the American Railway Engineering and Maintenance of Way Association. Sixth annual convention held at Chicago, March, 1905. Published by the Association, 1562 Monadnock Building, Chicago, Ill.

Fourteen of the standing committees presented reports and these, with the discussions, cover about 800 pages. The Committee on Buildings presented a number of recommendations relative to the requirements of a modern roundhouse. These recommendations favor the circular type, although considerable discussion was caused by a plan presented by Mr. D. MacPherson, of the Canadian Pacific, for a rectangular shed for 38 engines, each one of which can enter or leave the shed without shunting any other engine.

Practical Planer Kinks for Planer Hands. By Carroll Ashley. Published by the Hill Publishing Company, New York, 1905. 80 pages. Price, $1.00.

This book was written for planer hands by a planer hand who understands planer work and knows how to tell about it. After a brief description of the planer and some good advice to the operator, the tools, fixtures and clamps are considered. The rest of the book is devoted to the care and operation of the planer and to the best methods of handling various classes of work. It is profusely illustrated.

Physics. By Charles Riborg Mann and George Ransom Twiss. Published by Scott, Foresman & Company, Chicago, Ill., 1905. 450 pages. Price, $1.25.

Physics is a most interesting and important science, and yet how often, as we glance over the pages of a text book, are we impressed with the dry and uninteresting manner in which it is presented. The treatment in the above volume is radically different from the usual method and is interesting and attractive, as well as scientific. The style is simple and informal, and physical, rather than mathematical, arguments are used. A large proportion of the 238 illustrations are half-tone reproductions, showing practical every-day illustrations of the various principles. The book is primarily intended for a high school text book, but is equally well adapted to the needs of those who wish to take up the study of this subject by themselves. It contains no mathematics other than simple arithmetic and the simplest principles of algebra and geometry, and even these are not necessary to a comprehension of the greater part of the book. The treatment is such as to attract the student and to develop and foster the habit of scientific thinking. This book fills a long-felt want and will be found very valuable by those intending to take up the study of physics.

PERSONALS.

Mr. Robert O. Ferran has been appointed assistant foreman of engines of the Pennsylvania at Blairsville, Pa.

Mr. Milton McCara has been appointed machine shop foreman of the St. Louis Southwestern Railway Company, at Pine Bluff, Ark.

Mr. Max Toltz, who is acting in the capacity of consulting engineer for the Hill System, sailed for Europe the early part of November.

Mr. G. A. Bowers has been appointed master mechanic of the Wrightsville & Tennille, with office at Tennille, Ga., to succeed Mr. Lewis Archer, resigned.

Mr. H. H. Harrington, general foreman of the Erie Railroad at Susquehanna, Pa., has been appointed master mechanic to succeed Mr. W. H. Wilson, resigned.

Mr. Arthur C. Colson has been appointed master mechanic of the Dunkirk, Allegheny Valley & Pittsburg at Dunkirk, N. Y., to succeed Mr. Clarence A. Sherman.

Mr. B. H. Hawkins has been appointed master mechanic of the Delaware, Lackawana & Western at Buffalo, N. Y., succeeding Mr. F. W. Williams, resigned.

Mr. W. L. Garland has been appointed assistant general foreman of shops of the Pennsylvania Railroad at West Philadelphia, Pa., succeeding R. T. Garland, deceased.

The title of Mr. W. F. Ackerman, master mechanic of the Chicago, Burlington & Quincy, lines west of the Missouri River, at Havelock, Neb., has been changed to superintendent of shops.

Mr. John H. Ford has been appointed general car foreman and Mr. William H. Walker general foreman of shops and roundhouse, of the Lehigh & New England, with offices at Pen Argyl, Pa.

Mr. W. E. Knight, formerly assistant superintendent of motive power of the United Railways of Havana, has been appointed superintendent of motive power of the Cuba Railroad Company.

Mr. W. H. Wilson has been appointed superintendent of motive power of the Buffalo, Rochester & Pittsburg, with headquarters at Du Bois, Pa., vice Mr. E. E. Davis, resigned.

Mr. J. Kastlin has resigned his position as master mechanic of the St. Joseph Division of the Chicago, Burlington & Quincy Railway to become superintendent of the Davenport Locomotive Works, Davenport, Ia.

Mr. C. H. Burk, formerly master mechanic of the Mexican Central Ry., at Mexico City, has been appointed master mechanic at Chihuahua, to succeed Mr. W. J. Wilcox resigned. Mr. L. Strom succeeds Mr. Burk at Mexico City.

Mr. T. B. McCarthy, who recently resigned as general foreman of shops of the Southern Pacific at Ogden, Utah, has been appointed machine shop foreman at the Pittsburg works of the American Locomotive Company at Allegheny, Pa.

Mr. L. Strom has been appointed master mechanic of the Mexican Central at Mexico City, Mex., succeeding Mr. C. H. Burk, who has been transferred to Chihuahua, Mex., as master mechanic, to succeed Mr. W. J. Wilcox, resigned.

Mr. E. A. Williams, assistant general manager of the Erie, has been appointed general mechanical superintendent of that road and its allied and controlled lines, including the Cincinnati, Hamilton & Dayton, Pere Marquette and Chicago, Cincinnati & Louisville with office at 21 Cortlandt street, New York.

Mr. W. G. Hodgkinson has been appointed roundhouse foreman of the Lake Shore & Michigan Southern at Collinwood, O., in place of Mr. W. F. Kuhn, who has been appointed roundhouse foreman of the Dunkirk, Allegheny Valley & Pittsburg at Dunkirk, N. Y.

Mr. Max Howard Miner, a member of the editorial staff of the *Railway Age*, died November 7th, at the age of 29 years, after a brief illness, at his home in Brooklyn, N. Y. Mr. Miner, thus suddenly taken from that which he had determined to make his life work, was a young man of a rare kind. Endowed with a deep and joyous sense of humor, nevertheless, he took life seriously and believed in his work, finding in technical journalism an opportunity to uplift and advance many with whom he never came personally in contact. He was a painstaking, thorough student, and combined qualities which had already made him a factor in the current progress of railroad development, promising to become stronger and more influential as experience broadened and developed him, and extended the field of his efforts. He considered his work as most truly a profession, and his greatest pleasure came from a worthy task well accomplished. After graduation from Sibley College, Cornell University in 1899, he served as special apprentice in the motive power department of the Illinois Central Railroad for one year. In January, 1901, he became a member of the instructing staff at Cornell and continued as instructor until December, 1901, at which time he joined the editorial staff of the *Railway Age*. His work on that paper was of the highest order, and he was rising rapidly in the technical newspaper field when his sudden illness, apoplexy, overtook him.

Mr. Albert J. Pitkin, president of the American Locomotive Company, died at his home in New York City, November 16, after an illness of several months, the serious character of which was not appreciated or widely known among his closest friends. As the head of one of the greatest industrial organizations Mr. Pitkin's leadership extended in circles which are international in their scope. He was thorough, conscientious, enthusiastic, and his personality inspired his associates and subordinates to their best efforts. His leadership and his influence, combined with his ability, integrity, uprightness of character and unswerving devotion to duty, brought success as a matter of course. The high position which the Schenectady Locomotive Works attained among industrial establishments, was chiefly the result of his high ideals and earnest, unceasing efforts. As the managing head of these works he exerted an influence which reached far beyond the locomotive itself. Many improvements in motive power matters and methods originated with him, and he was deeply concerned in an effort to uplift and uphold the locomotive and motive power management. As an argument he often said: "The locomotive earns every dollar brought into the treasuries of railroads. It, therefore, merits the best attention railroad men can give it."

Mr. Pitkin was born at North Hampton, Ohio, in 1854. At the age of 17 he entered apprenticeship in the stationary engine works of the Webster, Camp & Lane Machine Company of Akron, Ohio. He spent a year in the locomotive repair shops of the Cleveland, Akron & Columbus Railroad, after which he entered the drawing office of the Baldwin Locomotive Works, for which he had prepared by diligent evening study. From this time he gave his attention to locomotive work. After five years at the Baldwin Works he became chief draughtsman of the Rhode Island Locomotive Works, and two years later, in 1882, was appointed mechanical engineer of the Schenectady Locomotive Works. In two years he became superintendent of the works. Upon the death of the president, Edward Ellis, Mr. Pitkin was made vice-president and general manager, and from that time developed the commercial, as well as the manufacturing features of the business which gave these works their high standing among the locomotive building companies of the country. Upon the formation of the American Locomotive Company Mr. Pitkin naturally became its first vice-president, and upon the death of Mr. Callaway, on June 1, 1904, Mr. Pitkin was made president. He never lost the impress received in the home of his father, a Presbyterian Home Missionary in Illinois, and his life was that of a consistent Christian man.

CATALOGS.

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS PAPER.

RADIAL DRILLS.—Circular No. 1A, from the Bickford Drill & Tool Company, Cincinnati, Ohio, is devoted to their new 2½ and 3 ft. radial drills, which are adapted for a medium class of work, and are described on another page of this issue.

DRAW BAR ATTACHMENTS.—A handsomely illustrated catalog, from the Butler Draw Bar Attachment Company, Cleveland, Ohio, is devoted to a description of the Butler draw-bar attachments and a number of drawings are presented, showing various applications.

MACHINE TOOLS.—The Progress Reporter, No. 9, published by the Niles-Bement-Pond Company, 111 Broadway, New York, illustrates a number of new machine tools, several of which are suitable for railroad shops. Four pages are devoted to the Niles electric traveling hoists.

COAL HANDLING MACHINERY.—Catalog No. 20 from the Jeffrey Manufacturing Company, Columbus, O., contains 142 pages and is largely devoted to illustrations showing the installation of their coal handling machinery in mines and illustrating the various details of this machinery.

ELECTRICAL APPARATUS.—Bulletin No. 61, from the Crocker-Wheeler Company, Ampere, N. J., is devoted to the large sizes of their belt-type direct-current machines. The cut-off blade starters used in connection with machines of this type are also described and illustrated in detail.

BALL AND ROLLER BEARINGS.—Catalog No. 12, from the Standard Roller Bearing Company, Philadelphia, Pa., contains 88 pages and is devoted to a detail description of their various types of ball and roller bearings, and also illustrates a number of typical applications of these bearings.

MECHANICAL DRAFT.—WHAT IT IS.—WHAT IT DOES.—This is the title of a neat little folder received from the B. F. Sturtevant Company, Hyde Park, Mass., which briefly presents the salient features of their mechanical draft system and presents several small views, showing various applications.

STEAM ENGINES.—Catalog W. M. 7004, from the Westinghouse Machine Company, East Pittsburg, Pa., is devoted to a description of their standard engine, many of the important features of which are described and illustrated in detail.

UNION PACIFIC MOTOR CARS.—Under this title the Union Pacific has issued a folder which is devoted to a description of motor cars Nos. 1 and 2, and contains some interesting information concerning the performance of these cars.

ELECTRIC MOTORS FOR MACHINE TOOLS.—Circular No. 15 from the Electro-Dynamic Company, Bayonne, N. J., is devoted to the power required by various machine tools. Circulars 16 and 17 are devoted to the advantages and the design of the inter-pole variable speed motor and its application to machine tools.

ROCK DRILLS.—Catalog No. 18 from the Chicago Pneumatic Tool Company, Fisher Building, Chicago, covers very completely and in detail their line of rock drills for quarry and mining work. Announcement is made of the fact that they have acquired the selling rights of the well-known McKiernan rock drills.

BUDA PRODUCTS.—The Buda Foundry & Mfg. Company, Railway Exchange, Chicago, have sent out a unique folder. On one side is a front view of a locomotive rushing through darkness at a high speed; opening the folder throws a semaphore signal to the danger position and forcibly calls attention to a signal advantage obtained by dealing with the Buda Company.

FOREIGN LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have issued "Record of Recent Construction," No. 54, which is devoted entirely to various foreign locomotives recently built by them. The frontispiece shows the Mallet compound, which was described on page 183 of our May issue, pulling a long train of gondola cars on the American Railroad of Porto Rico.

GRIP THE HEART OF THINGS IN DRAFT GEAR.—Under this title the Farlow Draft Gear Company, Baltimore, Md., have issued a very interesting pamphlet which considers the essentials of a satisfactory draft gear, and incidentally describes the Farlow gear. This book was intended primarily to appeal to mechanical engineers, and is worthy of close study by those interested in the draft gear problem.

ELECTRIC LIGHTING.—Two well illustrated and nicely arranged bulletins, describing the axle light system of electric lights and fans for railway passenger cars have been received from the Consolidated Railway Electric Lighting & Equipment Company, 11 Pine Street, New York. The first one is devoted to a general description of the axle light system, its operation and advantages. The second bulletin contains general instructions for the installation of this equipment.

HYDRAULIC ACCUMULATORS.—The Watson-Stillman Company, 46 Dey Street, New York, are sending out a new catalog, No. 67, which is devoted entirely to hydraulic accumulators and fittings. This is probably the first catalog of this kind that has ever been issued. It describes the various types of hydraulic, hydro-pneumatic and steam hydraulic accumulators made by them, together with the various attachments and valves which are used in connection with the accumulators.

NOTES.

WM. B. SCAIFE & SONS COMPANY.—This company of Pittsburgh, Pa., have been awarded the contract for a large steel frame building to be erected at Economy, Pa., for the National Metal Moulding Company.

AMERICAN BLOWER COMPANY.—In order to adequately care for continually increasing business this company of Detroit is erecting a three-story addition to its plant. This addition is rendered necessary by the growing popularity of their type "A" enclosed, vertical, self-oiling engine which was placed upon the market two or three years ago. The building will be of steel and brick construction. The first floor will be used for erecting and testing engines, a very complete new outfit being put in for the latter purpose. The power from engines under test will be absorbed by generators and air compressors. An electric crane will form part of the equipment. The second floor will be used for storing engine parts and painting the completed engines, and the third floor will be utilized for storage purposes entirely.

DUFF MANUFACTURING COMPANY.—This company of Pittsburg, Pa., was awarded a gold medal, highest award, on the Barrett track and car jacks at the Lewis & Clark Exposition, Portland, Oregon. The Barrett jacks were also awarded a gold medal at the Louisiana Purchase Exposition, St. Louis, 1904. It is said these jacks have been adopted as a standard for track and car work by practically every prominent railroad in the United States, as well as in many of the foreign countries.

THE RAIL JOINT COMPANY.—The Rail Joint Company was organized recently by filing at Albany, N. Y., a certificate of incorporation, with a capital stock of $1,500,000, of which $1,000,000 is common stock and $500,000 preferred stock. The officers of the company are: President, Frederick T. Fearey; vice-presidents, Lawrence F. Braine and Percy Holbrook; treasurer, Fernando C. Runyon; secretary, Benjamin Wolhaupter. This company will take over the business and properties of the Continuous Rail Joint Company of America, the Weber Railway Joint Manufacturing Company and the Independent Railroad Supply Company.

THE CRANDALL PACKING COMPANY.—This company of Palmyra, N. Y., have for some time been considering opening an Ohio office and the increasing demands of their trade have at last forced them to establish a branch at Cleveland. They have secured a store at 9 South Water Street, and have stocked it with one of the largest and most complete stocks of packing to be found in the city, and have placed in charge Mr. John M. Chapman, who for many years has been the manager of the Cleveland branch of the Garlock Packing Company. Mr. Chapman will be glad to meet all his friends at his new location, and his many years of experience in this line bespeaks a successful outcome of this new undertaking of the Crandall people. Mr. Chapman expects to make this branch office the headquarters for the engineers in his territory, and the combination of a good man and a good packing should prove a winner.

BUCYRUS COMPANY.—Mr. Carl A. Strom has resigned the position of superintendent of motive power and machinery for the Isthmian Canal Commission at Panama and accepted the position of works manager of the Bucyrus Company, South Milwaukee, Wis. Mr. Strom is well known as the former mechanical engineer of the Illinois Central R. R. with headquarters in Chicago, who resigned that position in May, 1904, to accept a similar position with the Isthmian Canal Commission. He was the first engineer under the Commission to go to Panama, having preceded Mr. Wallace by a month. He found the shops of the old French Company after twenty years' idleness, practically buried in the jungle, in a generally dilapidated condition and inside of a year's time Mr. Strom had four shops in complete commission and had overhauled and put in service over 75 of the Belgian locomotives and hundreds of the French cars. Considering the conditions of labor, the delay in receipt of material, and the general difficulties encountered, his work there has been recognized as phenomenal, and the conditions required just such physical and mental energy and ability as he possessed.

INDUSTRIAL ENGINEERING.—Crocker-Wheeler Company, manufacturers and electrical engineers announce the establishment of an industrial engineering department, in which is concentrated all their work in the line of industrial engineering as applied to railway shops, machine shops, and industrial plants of every description. This company was among the first to recognize that high-class electric motors and generators should be accompanied in every case with sound engineering advice to the purchaser. Each sale of a motor has meant with them that a motor-drive problem has been successfully solved by a group of engineering experts. The company are not only "manufacturers" but "electrical engineers." Among those who have availed themselves of the services of Crocker-Wheeler Company in this line are the Lake Shore & Michigan Southern Rd., John Simmons Company, Bucyrus Company, Ansonia Brass & Copper Company, American Bridge Company, Pittsburg & Lake Erie Rd., Joseph Dixon Crucible Company, Ingersoll-Sergeant Drill Co., etc. Mr. J. K. Warner Davenport, E. E., formerly a consulting engineer making a specialty of industrial work, has become associated with the company in order that its growing activities along these lines may be handled in as thorough and satisfactory manner as heretofore. Mr. Davenport and his staff of assistants are at the present time giving personal attention to several important industrial propositions.